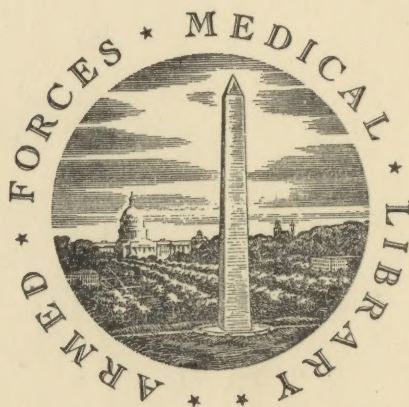




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MEDICAL SUPPLY SERVICES SCHOOL, St. L.
TEXT BOOK

VOLUME II

X-RAY

SECTIONS XXXVI TO LXXIV

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by the War Department. It has been prepared
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SECTION XXXVI

**KELEKET TYPE
KY - 30 M. A. MOBILE UNIT**

SECTION 1001

RELEASE TYPE

RY - 30 M. & MOBILE UNIT

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

INSTRUCTIONS FOR THE INSTALLATION AND OPERATION OF TYPE "KY" 64 STEP MOBILE UNIT

UNPACKING - Care should be taken in unpacking, so as not to damage any parts. Check and examine all packing cases so as not to overlook any small parts in unpacking material. Should there be any parts damaged, notify the Medical Supply Officer at once. Special care should be given to handling the Self Contained Energizing Tube Head, so that it is not damaged.

Generally the entire Mobile Unit is packed in one large crate with partitions to hold the several pieces. Refer to Assembly Drawing of "KY" Mobile Unit. It will be found that the *Base Casting* mounted on wheels, *Cassette Box*, *Vertical Column*, and *Telescopic Carriage* are left assembled and braced inside main crate. The partitions will contain the following: The *Control Member* is shipped with Control Bracket Castings in place and Entrance Cable is left connected thereto. The Timing Unit with cable is wrapped separately. The *Self Contained Energizing Tube Head* with *Yoke* and *Sleeve Member*, and a KXX-12 Cone will be found packed separately. A full set of double diaphragm cones may be ordered such as KXX-5, 7, 9, 12 and 20.

ASSEMBLY - Refer to Assembly Drawing Showing relation of parts.

The Control Unit with its Control Bracket Castings is positioned on top of Cassette Box and fastened permanently with six bolts from inside of Cassette Box top member.

To conveniently inspect and make connections it is suggested that both Control Swivel Plates be removed by loosening two screws; which allows entire control to be inverted.

Access is gained to the Terminal Board and parts on the Control Unit by removing the two screws on each side of the Control Housing then removing the case.

Generally speaking the Telescopic Carriage Member is pulled down to convenient level and Vertical Lock clamped into place and braced, then the Carriage Member held in this position while transformer and tube head is positioned.

The *Self Contained Transformer* and *Tube Head* with *Yoke* and *Sleeve member* are to be mounted to Telescopic Carriage Member by moving *Yoke Sleeve* in place over keyed bearing surface. The Angle Lock stud not only acts to lock the angular motion of Head, but the recessing of stud extension in bearing slot holds Head to Carriage Member. A set screw is employed against the action of Angle Lock so that it has a limited motion and may not be entirely withdrawn. *IT IS VERY IMPORTANT THAT THIS SET SCREW BE PROPERLY POSITIONED.*

The "KXX" Cone is readily mounted by loosening two thumb screws.

CONNECTIONS TO BE MADE - The terminal board is on the right hand side (looking from the front). The terminals are marked "X-Y-M-G-F-F". They are to be connected to the leads marked in a corresponding manner on the cable coming from the tube head. Also on this terminal board are two terminals marked "A-C MAIN", to which are to be connected the main line cable coming from the power supply. A 120 Volt 60 Cy. A.C. single phase line is required. The auto-transformer has taps arranged to take care of 220 volt lines.

Several taped leads will be noted coming from the auto-transformer. These leads are to be used for line voltage adjustment. The apparatus is shipped for use on a 119 volt supply line. In order to determine which auto leads are to be used first measure the line supply voltage with an accurate voltmeter. It will be noted

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

that the Minor and Major auto-adjuster leads are connected at the Main Switch see print B-71480-4. A Minor Adjuster auto tap of 3.5 and a major auto tap of 122.5 are shown connected to Main Switch contacts which is proper for 119 Volt line as the difference between 122.5 and 3.5 taps is a 119 Volt relation. The following major auto taps are to be found on auto-transformer altho not indicated in Print B-71480-4 such as 203, 210, 217, 231, 238 and 245 taps. Minor taps 0, 3.5 and 7. are also included in the auto arrangement. If line voltage is 220 Volts then Auto Minor 0 tap and Major 217 should be brought up to the Main Switch instead of 3.5 and 122.5 taps. Taps 7. and 231 would also answer the purpose.

ADJUSTING THE TECHNIQUE SELECTOR - If the machine is to be operated on 110 volt supply line (or voltage close to this) it will not be necessary to readjust the Technique Selector.

If it is to be operated on 220 volts it will be necessary to readjust the technique selector circuit. The first step in this procedure is to short out the Slope Resistor (this resistor is attached to the terminal board and is in series with the kilovolt meter). (It is a small adjustable wire wound resistor shown as 2000 Ohm type with jumper connection. The entire resistor should be shunted out of circuit on 220 V.)

Next remove the "X" and "Y" leads from the terminal board and attach a voltmeter to the "X" and "Y" connections. Turn the machine on and adjust the auto-transformer switch on the control panel till this voltmeter reads 91 volts. Now turn the technique selector control till the kilovoltmeter reads 60 kilovolts. Turn the scale beneath the Technique Selector till the indicator points to the 20 milli-ampere marking. This should set the kilovolt meter circuit for all normal operation on a 220 volt supply line.

ADJUSTING TECHNIQUE SELECTOR TO COMPENSATE FOR POOR LINE - It may be noticed when operating on either 110 volts or 220 volts that the radiographs will show either too much or too little kilovoltage, due to an unusually good supply line or an unusually poor supply line. When this occurs it can be compensated for by turning the scale under the Technique Selector so that the Kilovolt meter will read the desired value for the milliamperage that is being used. In such a case the load-voltage calibration chart either for 110 V. or 220 Volt should be employed in properly setting scale on Technique Selector.

If the machine has been operating on 220 volts and then placed on 110 volt operation it will be necessary to remove the shorting jumper from across the Slope Resistor so as to place this resistor back in series with the kilovolt meter.

MAIN LINE SERVICE - The main line capacity for the maximum operation of the "KY" Unit is 3 KVA. This capacity will permit the use of 30 milliamperes at 90 PKV. Fluoroscopic work requires a maximum of 1/2 to 1 KVA. With reference to the size of service wires, it is well to remember that the heavier the wire, the smaller the voltage drop and consequently the smaller the inverse voltage on the X-Ray tube. The following tables give the proper service wires per technique:

TECHNIQUE	LINE VOLTS	FUSES	MINIMUM SIZE OF SUPPLY WIRES		
			200 ft.	100 ft.	50 ft.
90 PKV 30 MA	110	30	No. 6	8	8
90 PKV 20 MA	110	20	8	10	10
90 PKV 10 MA	110	12	10	12	12

A rotary converter of proper size is to be used with this apparatus when used

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

on Direct Current.

It will be noted that the main line cable contains three wires. Two wires carry the proper energy to the Unit while the third wire is the *Ground* wire and should be connected to proper electrical conduit ground or standard water pipe ground. *Do Not Employ* heating system or gas pipe ground.

CONTROL UNIT - It is assumed that proper control wire connections have been accomplished and the Control Housing replaced. Replace the two set screws on either side, also two Control Swivel Plates.

Three meters are placed across the top of the Control Panel. The left hand meter is a milliammeter, the center one is an X-Ray filament indicator, and the right hand meter is a calibrated Kilovolt meter indicating kilovolts applied to the tube.

On the left side of the control panel and directly below the milliammeter is a filament control used to vary the X-Ray tube filament current and thus the milliamperage. Below this is the Main Switch, which breaks both sides of the incoming supply line.

In the center of the panel, directly below the filament indicator is a Technique Selector used to adjust the calibrated kilovolt meter so that it will read directly in kilovolts applied to the X-Ray tube for any milliamperage within the rating of the machine. Below the Technique Selector is the Overload Relay knob, and below this the Overload Relay adjustment. The relay knob must be pushed down before the machine will operate. If for any reason the current going to the X-ray tube should exceed that for which the relay is adjusted, the relay knob will be thrown up and power automatically disconnected from the high-tension circuit. The relay adjustment should be placed so that it will allow the relay to stay in for the particular milliamperage being used, but will throw out if a greater current flows.

On the right-hand side of the control panel are two auto-transformer control switches, one being for major adjustments of the kilovoltage, and the other for minor adjustments. With these two control switches any kilovoltage within the range of the unit can be obtained.

On the right side of the control case is a receptacle into which either a timer or a footswitch can be plugged.

TESTING - Having checked all connections to see that they are properly made, make certain that the Main Switch is on the "off" position. Then connect the main line to a source of suitable electricity. (60 cycles A.C., voltage for which the auto-transformer was adjusted.)

Before turning on the main switch, turn both the Filament Control and both Auto-Transformer Switches to the low position or in a counter-clockwise direction, to their minimum value, as well as the relay adjustment.

To operate unit, push down the relay knob and turn the Main Switch to the "On" position. The calibrated Kilovolt meter and Filament meter should both indicate. If the Kilovolt meter does not indicate, turn the auto-transformer switches slightly to see that they have not been stopped on a mid-position. If the Milliammeter should indicate at this time, immediately turn the Main Switch off and check the control circuit.

With the filament meter and kilovolt meter indicating you should now plug in

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

the hand timer supplied with the unit and completely depress the exposure button. When this is done the milliammeter should read slightly. (It is advisable when testing the milliamperage to set the timer to some low value such as a one-second--by turning the indicator in a clock-wise direction to the desired time value--and not make any test exposures longer than this in order to save the tube.)

When the filament control is turned slightly in a clock-wise direction and the timer button pressed the milliamperage should increase. Any desired milliamperage within the limits of the machine can be obtained by turning the filament control further to the right or more clockwise.

The auto-transformer switches can now be turned in a clock-wise direction and kilovolt meter should indicate a higher value as they are turned to the right. *DO NOT CHANGE THE AUTO-TRANSFORMER SWITCH ADJUSTMENT WHILE THE TIMER OR FOOTSWITCH IS TURNED ON, OR IF FOR ANY REASON THE MILLIAMMETER IS INDICATING.*

Now change the Technique Selector and notice that the kilovolt meter will read differently, showing a lower reading as the selector is turned to a higher milliamperage. For Kilo-volt meter to read accurately, the Technique Selector must be set for the Milliamperage to be employed for X-Ray exposure.

If the Overload Relay should be thrown out at any time the X-Ray timer, or footswitch (whichever is being used) should be turned off and the relay knob pushed down. The adjustment should be turned to the right or in a clock-wise direction slightly before turning the X-Rays on again.

OPERATION - To operate the "KY" Mobile Unit the following procedure should be followed: Push down the Overload Relay; turn the Technique Selector to the Milliamperage to be used; turn the Main Switch on; adjust the auto-transformer switches till the Kilovolt meter reads the desired kilovoltage; set the filament control till the filament meter reads the approximate value corresponding to the desired milliamperage; turn on the Timer or Footswitch and read the milliamperage; if the milliamperage is not at the desired value adjust the filament control to the desired value.

After completing an exposure always turn the Main Switch off so as to prolong the X-Ray tube life.

CASSETTE BOX - The Cassette Box acts as a mounting for the Control Unit, besides accommodating cassettes for Mobile purposes. The Cassette Box shipped with unit is not lead-lined protected, although the material thickness acts to protect cassettes from indirect and scattered radiation. (Direct radiation of 30 MA, 90 PKV, and 30" distance pointed at Cassette Box for 20 seconds will slightly fog the films.)

A lead-lined protected Cassette Box may be furnished on order at increased cost.

WHEEL LOCK - Control for the wheel lock which acts on both front wheels and insures positive locking action for the unit is located directly below and on the operator's side of the cassette box. This lock may be released by foot pressure against back stop.

COUNTERBALANCE - Special mechanical means acts to suspend the Vertical Rider and entire weight of *SELF CONTAINED HEAD*. This counterbalance provides a perfect means of compensation for the weight of the tubehead and associated equipment, but does not add the weight usually associated with a counterweighing system. At the time the "KY" unit leaves the factory the counterbalance system is properly adjusted and should not need any additional adjustment. The vertical lock shown on the

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

illustration locks the tubehead and vertical rider in position under all conditions of counterbalance. If system needs balancing then remove Vertical Column Cap from top of upright exposing vertical adjustment bolt.

SAFETY CATCH - In the "KY" mobile unit you have an added safety feature in the form of a safety catch, which will act to hold the vertical rider and prevent it failing in the event that the suspension cable should break. This is in the form of a disc or plate about the vertical column directly above the vertical rider. This can be released by simply raising the vertical rider.

TURN TABLE - The ball bearing Turn Table is not seen in photo, but is enveloped in Telescopic Carriage member and attached to Vertical Rider. This allows a motion of Tube Head in a horizontal plane through an angulation of 360 degrees. Swivel lock as indicated clamps this motion.

TELESCOPIC CARRIAGE - The Carriage is a double telescopic member which allows full extension with the greatest ease while in no position does the member protrude beyond the main vertical column. Motion of extension may be controlled through Carriage Lock. With this means of suspending Self Contained Head, the operator is allowed free and full angulation at the end of carriage motion without interference of other structural members.

STEREOSCOPY - A stereoscopic Member proper for 25" to 30" target to film distance is interposed between extension members of Telescopic Carriage. Normally the center of tube marked by large **RED DOT** on either side of Tube Head is angled so central ray is in proper projection; then stereoscopic rider is brought centrally and clamped. Tube Head may now be shifted to both limits of stereoscopic frame to accomplish stereo shift. Beside the simple shift, the tube may be angled into center at each stereo limit approximately three degrees for true Stereoscopy.

The **SELF CONTAINED HEAD** is mounted in **YOKE MEMBER** so that the tube center may take total angulation in every possible radiographic position. Three scales with double pointers indicate angular alignment. It will be noticed that the "KXX" Cone shows the X-Ray tube mounting to be off center. For certain lateral radiographic projections in bedside work it is required that plane of tube center be as low as possible in relation to bed. This is accomplished by moving Head and Yoke member through 180 degrees from position indicated in assembly photo.

NOTE: (If Self Contained Head, due to shipping or handling shows signs of oil on surface or gasket, then **CAP PLATE** should be removed and Head turned upward so oil level may be inspected by removal of **OIL PLUG**. All air should be replaced with proper Transformer Oil as indicated in Instructions for Replacing X-Ray Tube.)

CONES - Unless otherwise specified, one cone only is shipped with Mobile Unit, which is known as KXX-12 Cone. The KXX-12 Cone is designed to double diaphragm the Central Radiation emanating from the tube and therefore project a field at 30" of 12" Diameter and at 20" a 9" Diameter.

FLUOROSCOPY - The "KY" Mobile Unit may be employed for Fluoroscopy. For Fluoroscopy the milliamperage is always adjusted between 3 to 5 milliamperes, and the Technique Selector turned to this value. The part to be fluoroscoped should be measured as a guide for setting the proper kilovoltage.

The rating for fluoroscopic work when starting with a cold target is 20 minutes at 5 milliamperes and 85 PKV. After any considerable radiographic work the target is never cold, and therefore a maximum of 10 minutes should be the limit, then tube allowed to cool before continuing operation.

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

INSTRUCTIONS FOR REPLACING X-RAY TUBE IN 90-A-1 HEAD

Should a tube replacement ever be necessary, there will be required besides the X-Ray Tube, a replacement of Transformer Oil, New Head Gasket, Oil Plug Gasket and sealing compound known as Oil Stop.

PROCEDURE -

Turn Self Contained Head so that *CAP PLATE* is uppermost.

Remove screws from *CAP PLATE*.

Drain Oil from Head by removing *OIL PLUG*.

Remove all screws from outer edge of Top of Head. (Use good screw driver so as not to burr screw heads.)

Lift top. (If necessary use screw driver inserted in grooves at each corner): Exercise care not to damage tank flange or top.

NOTE: (Entire unit is assembled on Top.)

Turn assembly over on the *TOP* so that tube is readily accessible. Note how filament and anode connections are made, then disconnect tube.

Remove outside screw that holds brass band which clamps tube to bakelite casting, spring band back far enough to permit removal of tube. Replace tube with new one and clamp into place with band as mentioned and make connections. If necessary shorten filament leads of tube and be sure that leads do not extend so as to cause sparking to grounded parts.

Clean gasket, coat groove in tank with sealing compound known as Oil Stop and place new gasket in groove. Coat top of gasket thinly with sealing compound. (Do not apply too much sealing compound. Use just enough to cover and spread evenly.) (WARNING - Read directions sent with *OIL STOP*, use rubber gloves and keep compound away from skin.)

Place assembly in tank and screw top firmly into place.

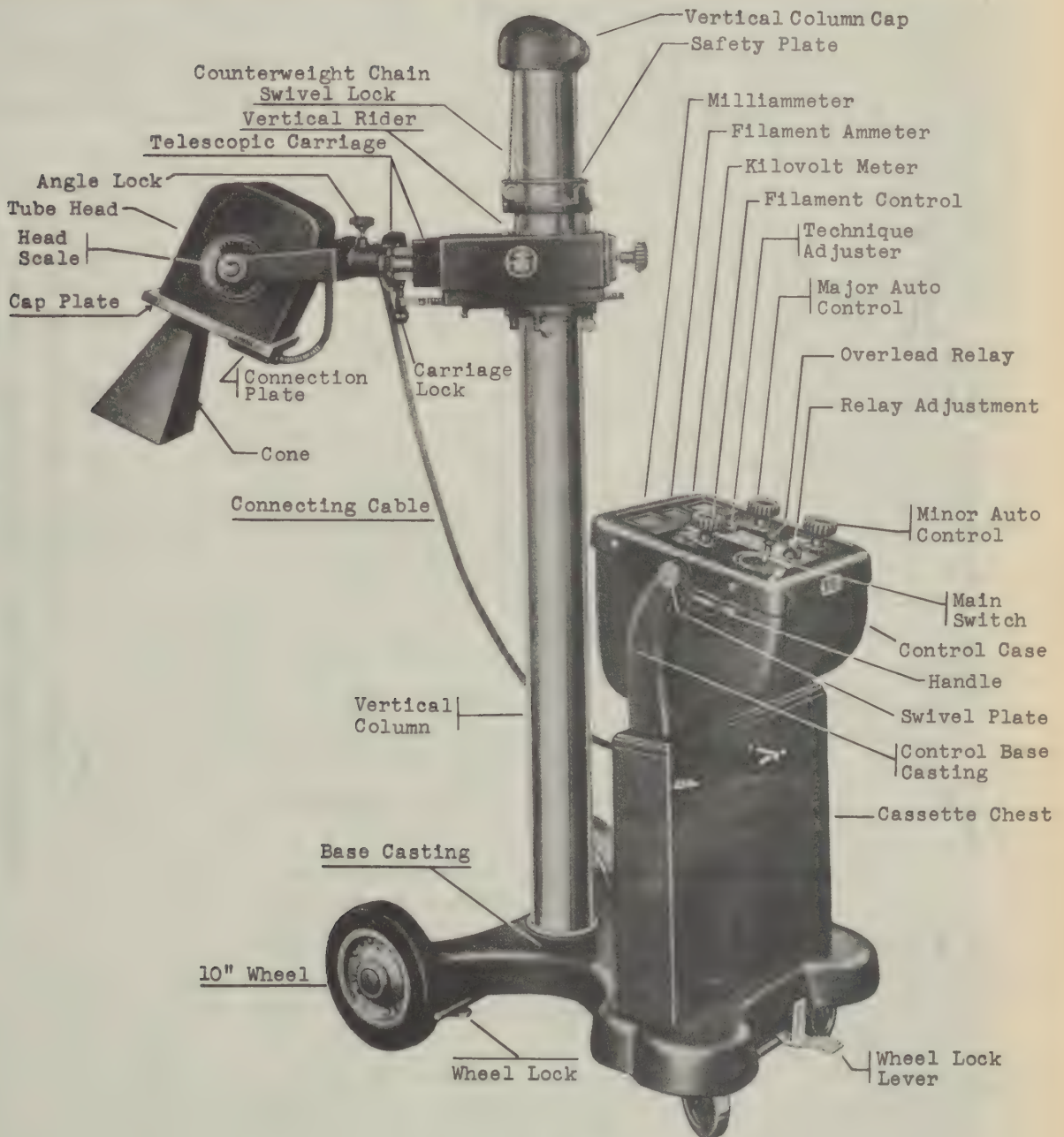
Fill unit with *NEW OIL*, (3 gallons required) until within one half inch of top, rock unit for approximately *15 minutes* to exclude all air from oil, then tilt slightly so that oil hole is higher than rest of unit and fill completely.

CAUTION - (Unit must be full of oil and all air eliminated; otherwise discharge of high tension to case will result when voltage is applied.)

Insert Oil Plug and set machine to read 5 M.A. and to show 50 kilovolts on K.V. meter and run for three minutes; then remove oil plug and replace any escaped air with oil and repeat three or four times, finally inserting oil plug for maximum voltage test.

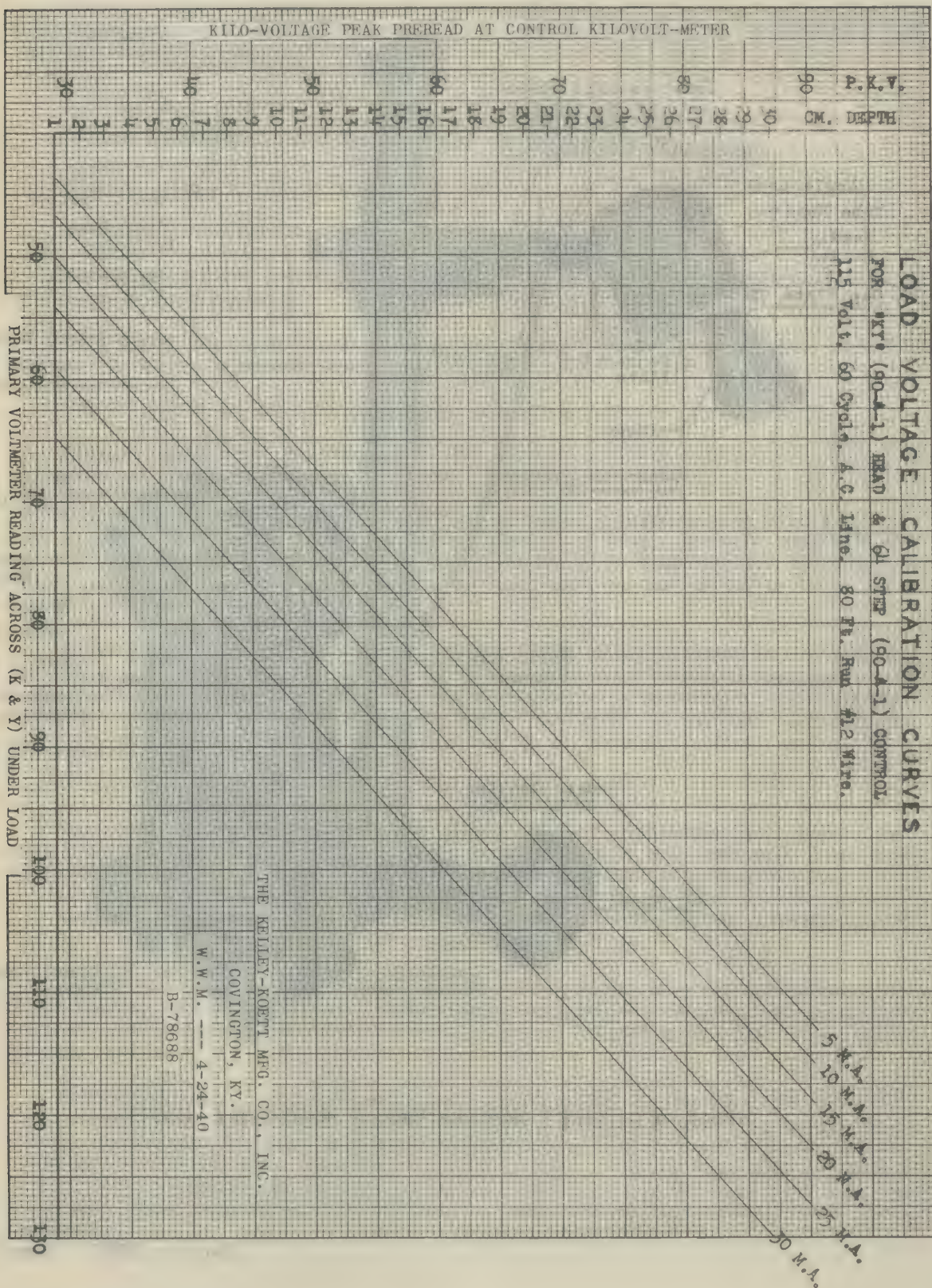
As a final test of self Contained Head, apply 60 K.V.P. then 75 K.V.P. at 5 M.A. intermittently and rotate unit in every position. No spitting or discharge should occur. Should any discharge take place within the head, then proceed again as indicated above and make sure that Head is full of Oil. Finally test unit at 30 M.A. 70 K.V. for 3 seconds then advance to 30 M.A. 80 K.V. then 30 M.A. at 87 K.V. for 3 seconds. Make sure Technique Selector is always set for Tube load in M.A. being employed.

KELEKET TYPE "KY" 30 M.A. MOBILE UNIT

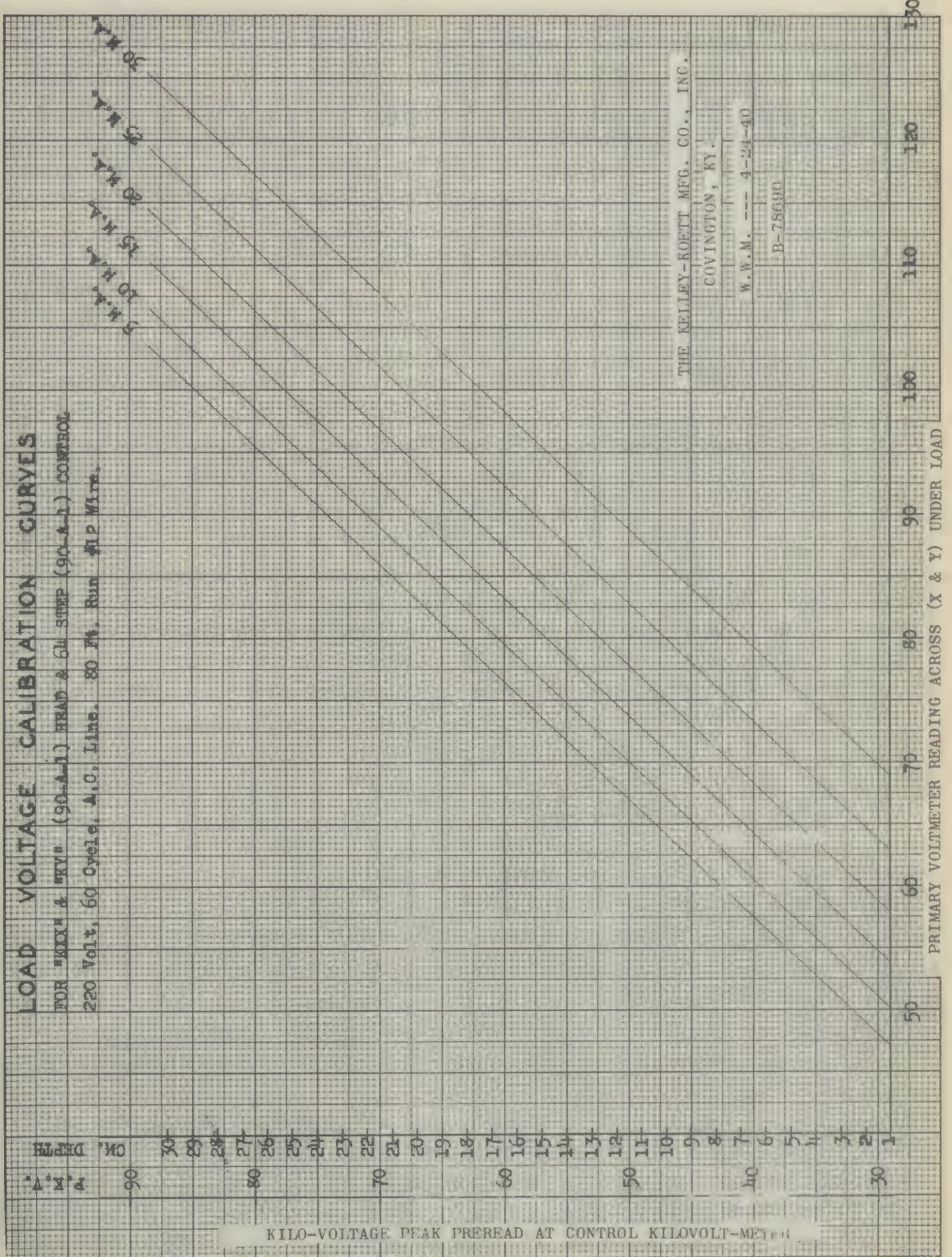


THE KELEKET KY MOBILE BEDSIDE UNIT

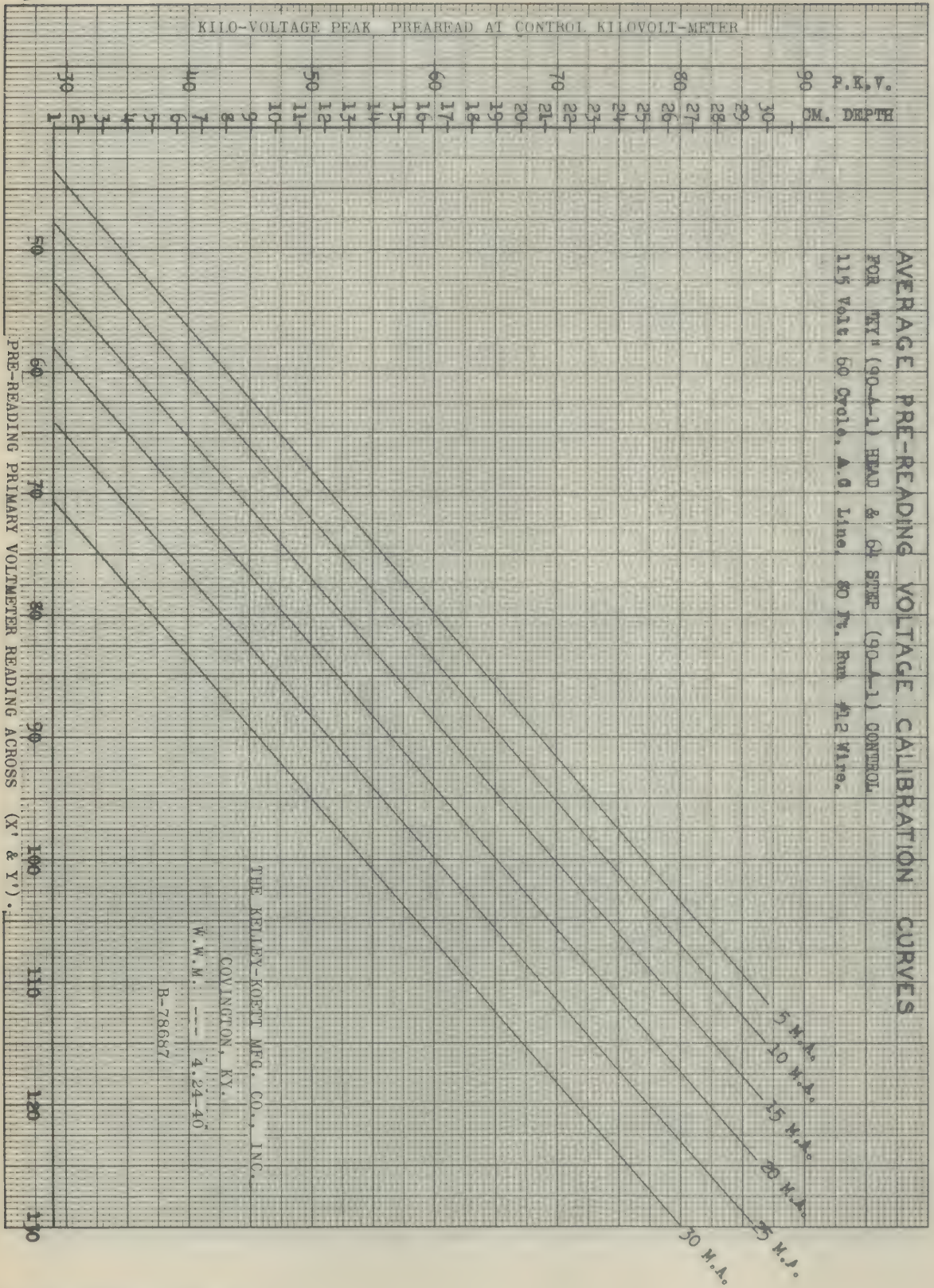
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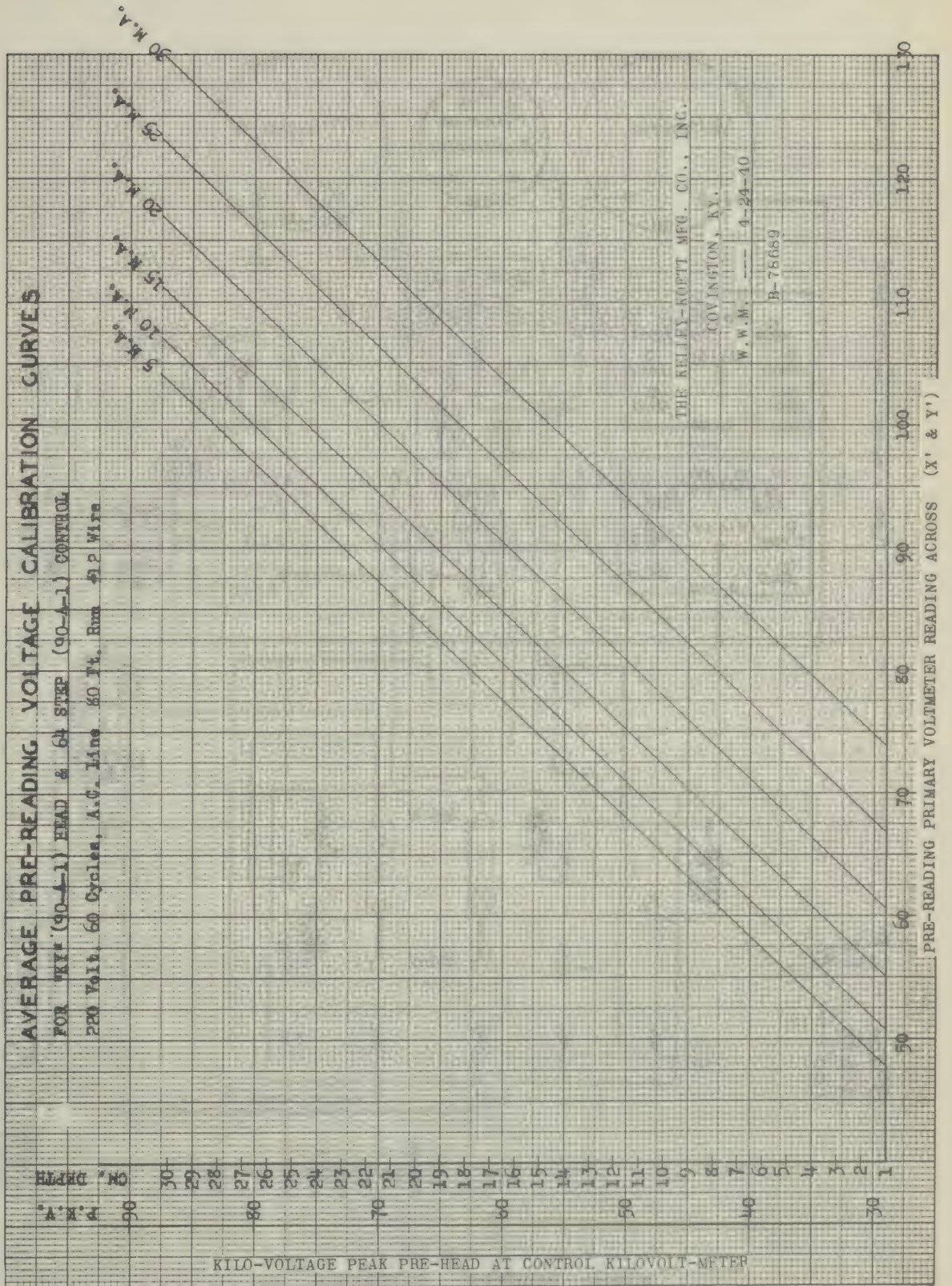
KELEKET TYPE "XY" 30 M.A. MOBILE UNIT



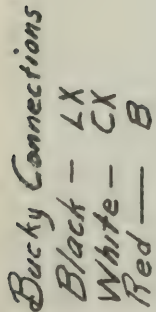
KELEKET TYPE "KY" 30 M.A. MOBILE UNIT



KELEKET TYPE "KY" 30 M.A. MOBILE UNIT



KELEKET TYPE "KY" 30 M.A. MOBILE UNIT



WIRING DIAGRAM B-71480-4

SECTION XXXVII

MODEL - E 60 - SHOCKPROOF MOBILE UNIT

SECTION XXIV

MODEL - E 00 SMOOTHER
MODEL UNIT

MODEL "E-60" SHOCKPROOF MOBILE UNIT

INSTRUCTIONS - Unpack carefully to prevent injury to the finish of the apparatus. If any articles arrive broken, or in damaged condition, report immediately to the Medical Supply Officer. Do not throw away any of the packing material until the apparatus has been assembled and found to be complete.

ASSEMBLY - Set the base on the floor. Remove the collar and ring from the tube column hole in the base and slip them over the tube column. Set the tube column down into the hole. Work the tube column down into the hole as far as it will go and screw the collar down on the ring tightly. Mount the tube rail on the sliding sleeve. The lock for horizontal movement will face the tube head. Connect the cable lugs to the correspondingly labeled studs on the transformer case. Clamp the cable in place with the cable terminal cover.

RATING - This generator is rated to deliver 30 MA at 85 PKV, or 5 MA at 89 PKV when connected to a suitable 110 volt alternating current supply. It is rated to deliver 60 MA at 85 PKV or 5 MA at 89 PKV when connected to a suitable 220 volt alternating current supply.

The generator itself is capable of delivering 89 PKV at 60 MA. This, however, is more than the maximum rated capacity of the x-ray tube. Therefore, when using more than 10 MA, the auto controls should not be set higher than 85.

CAUTION - Before operating the generator:

Remove the vent screw from the oil plug in the transformer top.

Examine the oil level in the transformer, and, if necessary, add *transformer oil* to bring the oil level up to not more than $\frac{1}{2}$ " from the top.

LINE CONNECTION - On each side of the control stand base casting will be found a covered receptacle. The one on the right hand side is labeled "110 Volts", and the one on the left hand side is labeled "220 Volts". The 110 Volt receptacle is a 3-prong unit which corresponds with a 110 volt line cable. The 220 volt receptacle is a 4-prong unit which corresponds with a 220 volt line cable. Either or both of these cables may be ordered and used. The unit will work on either 110 or 220 line volts. No adjustments other than the connection of the line cables are necessary. It is impossible to interchange the line cables at the control stand receptacle because one is a 3-prong and the other is a 4-prong receptacle. The covers on the receptacles are plainly marked also. Caution on the user's part will have to be taken to see that the voltage applied to the unit corresponds to the voltage connection at the line cable receptacle.

OPERATION - After assembly is complete, and after the line cable has been connected to the proper source of alternating current, the machine may be operated as follows:

Turn the filament controller to the left as far as it will go.

Raise the knurled knob of the circuit breaker to the on position.

The meter dials should now be illuminated and the compensator meter should read, the x-ray filament meter should also read, the x-ray tube should be lit. If the tube does not light up, turn the filament control to the right until it does.

Adjust the compensator switch until the compensator meter reads 10. The compensator meter is a volt meter connected to the auto transformer. When this meter reads 10, any variation in line voltage has been compensated for, and the voltage applied to the high tension transformer is correct for any milliamperage from 0 to 20. For milliamperages between 20 and 40, set to 30 on the meter. For milliamperages between 40 and 60, set to 50 on the meter.

MODEL "E-60" SHOCKPROOF MOBILE UNIT

NOTE: If the compensator switch is unable to make the meter read correctly, and if the meter persists in reading too high, shift the proper line voltage adjuster wire to a higher numbered stud on the major auto control. If the meter persists in reading too low, shift the adjuster wire to a lower numbered stud. The 220 Volt Line Voltage Adjuster wire is the heavy wire which runs from the 220 V Line plug up to Stud #80 on the major auto control. The 110 volt voltage adjuster wire is the heavy wire which runs from the 110 V line plug up to Stud #40 on the major auto control.

CONTROL STAND - Before touching the inside of the control unit, disconnect the line plug from the source of current.

The terminal connections to the control unit are located on the lower rear part of the distribution board and are properly labeled. A diagram of connections will be found inside the control stand housing. If there is ever any need to get at the inside of the control stand, the following procedure should be used.

Loosen the four screws in the corners of the control stand top. Also loosen the set screw which is at the center of the back edge of the top. This connects the primary cable wires from the high tension transformer.

Lift the channel which encloses the cable wires and which is attached to the back wall of the control stand. Lifting this channel will cause it to be disengaged at its lower end, and will enable it to be removed altogether. The control unit can now be lifted out from the control stand.

This one adjustment of the compensator meter is the only adjustment that should be made. Adjust the meter to read "10" or "20" or "50" as needed, *before* the x-ray switch is closed. When you close the x-ray switch, the meter reading will drop more or less, depending upon the condition of the line wiring which supplies current to the x-ray machine. This drop in the meter reading serves the useful purpose of showing whether you are overloading the wiring which supplies the machine. If the meter reading drops more than 20 points, as from 30 to some point below 10 when operating at 30 MA, you will know that 30 MA constitutes an overload on your line wiring, and that you will obtain better results by reducing the milliamperes to a value which will not cause the excessive drop in this meter reading.

Adjust the auto controls to the desired kilovoltage. Turn on the x-rays by means of the hand timer and adjust the milliamperes to the desired value.

X-RAY FILAMENT PRIMARY AMMETER - This meter is supplied for use especially in radiography for the pre-setting of filament current to give the desired milliamperes. This meter measures the primary current of the x-ray filament transformer. It is provided with an evenly divided arbitrary scale for easy reading.

An adjustable shunt on the back of this meter permits adjustment of the meter scale to suit the characteristics of your x-ray tube or tubes. The shunt can be set so that this meter will read at the lower end of its scale on fluoroscopy, and at the higher end of its scale for radiography. Such an adjustment of the meter enables the operator to pre-set the x-ray filament current to obtain the desired milliamperes. If these filament meter settings are recorded for the various milliamperages and kilovoltages that are used, all necessity for frequent testing of milliamperes will be eliminated, and x-ray tube life will be prolonged.

To adjust the shunt, set the auto controls to deliver about 50 PKV. Set the filament controller to obtain the highest milliamperage that the operator will use

MODEL "E-60" SHOCKPROOF MOBILE UNIT

in his radiographic work. Adjust the shunt on the back of the meter so that the meter will read about 90 on its scale.

Next, adjust the filament controller to bring the milliamperes down to about 5. The meter should now read somewhere near the lower end of its scale. If it does, no further adjustment is necessary. If it reads too high or does not read at all, the zero adjuster on the meter can be turned to give a desirable reading. The setting for high milliamperage should then be checked again. If necessary, readjust the shunt to give a desirable high reading.

Greatest accuracy will be obtained in pre-setting for desired milliamperes, if the meter is adjusted so that as much as possible of the meter scale is used in making the various filament settings.

INSTRUCTIONS FOR MODEL "E" SHOCKPROOF X-RAY TUBE

GROUNDING - The tube stand which supports the shockproof tube *must be grounded* to a water pipe or other good electrical ground. The x-ray tube housing must be attached to the tube stand so as to secure good electrical contact between the housing and the tube stand, in order that the x-ray tube housing may also be well grounded. *This grounding is necessary to make the installation shockproof.*

NOTE: The EBRF Tube Stand is automatically grounded by the transformer and "line" cables when installation has been made in accordance with instructions.

CARE OF THE X-RAY TUBE - Over ninety-nine per cent of the electrical energy that enters the x-ray tube head is turned into heat, almost all of which is concentrated in the focal spot of the tube. Consequently, overheating and overloading of the focal spot must be guarded against. Remember - one accident or one act of carelessness may ruin the tube.

The size of the focal spot or spots of your tube is shown on the name plate that is attached to the shockproof casing. Be sure that the rating chart which you use is the correct one for the focal spot that you are using. Do not exceed the rated capacity of the tube either in time, in milliamperes or in kilovolts.

TESTING - Do not waste too much time in testing milliamperes, especially when high milliamperage is used. The time required to read the milliampere meter is usually considerably longer than the time required to make the radiograph with high milliamperage. Therefore, the danger of overheating the tube while testing is considerably greater than the danger of overheating the tube while making the radiograph.

The likelihood of overheating the tube is further increased if the radiograph is made immediately following the testing, without allowing the tube to cool off.

The tube must be allowed to cool off after testing in order that the tube anode may not be hot, before the radiograph is made. If it is hot at the beginning of a heavy exposure, it will be overheated before the end of the exposure.

In testing the tube for high milliamperage, it is well to make the test with about 60 kilovolts in order to determine the correct filament setting. The kilovoltage can then be adjusted to the desired value.

Be especially careful when testing and adjusting milliamperes. Remember the rating chart and, *DO NOT KEEP THE X-RAYS TURNED ON TOO LONG.*

MODEL "E-60" SHOCKPROOF MOBILE UNIT

RATING CHART - SELF-RECTIFIED

STANDARD MODEL "E" OIL IMMERSSED SHOCKPROOF X-RAY TUBE UNIT WHEN USED WITH SELF-RECTIFIED GENERATORS

NOTE: Do not operate the tube at more than 90 PKV unless your generator is equipped with an inverse suppressor.

BE SURE - DON'T BE SORRY

RATING CHARTS - The times shown on the chart indicate the maximum exposures the tube can stand when the anode is cold. If the tube anode is not cold, either wait for it to cool off or reduce the exposure. The tube is assumed to be "cold" when the shockproof casing is not uncomfortably warm to your touch, and when the tube has had two minutes in which to cool off following the last exposure.

The two exposures of a stereoscopic pair should be added together and considered as one exposure which should not exceed the tube rating. Two minutes cooling time must be allowed the tube between successive heavy exposures.

A long series of fluoroscopic examinations or radiographic exposures may prove sufficient to heat the tube case to a temperature that is uncomfortable to touch. When this occurs, the outfit should be allowed to cool off.

Watch the milliampere meter, especially on long or heavy exposures. A sudden rise in milliamperes during such an exposure indicates overheating of the tube and warns that x-rays must be turned off immediately.

RATINGS (3.2 mm) Focal Spot

40 MA	90 PKV	15 Sec.
50 MA	90 PKV	4 Sec.
50 MA	80 PKV	10 Sec.
60 MA	90 PKV	½ Sec.
60 MA	80 PKV	2 Sec.
60 MA	70 PKV	7 Sec.
60 MA	60 PKV	15 Sec.
5 MA	90 PKV	12 Min.
5 MA	85 PKV	20 Min.

INSTRUCTIONS FOR MODEL "E" SHOCKPROOF TUBE HEAD

TUBE HEAD OIL - The oil supply inside the tube casing may be checked as follows when the tube is cold:

Remove the gauge screw which is in the back of the bellows cover. The sole purpose of this screw is to act as a gauge when adjusting the quantity of oil inside the casing. Remove the bellows cover. Remove the heavy coil spring that is inside. Replace the bellows cover.

Turn the tube head so that the small nickel plated plug that is in one of the end caps is at the top. Unscrew the oil plug with a wide heavy screw driver and insert the gauge screw in the small hole which is in the center of the bellows

MODEL "E-60" SHOCKPROOF MOBILE UNIT

cover. Press it in so that the head of the screw rests firmly against the bellows cover.

If there is too much oil in the tube head, the excess oil will run out. If it contains too little oil, add enough of the special *Marcol* to fill the head full to the top of the oil plug hole, and then replace the oil plug while holding the gauge screw in place. Replace the spring inside the bellows cover.

CHANGING THE X-RAY TUBE INSIDE THE TUBE HEAD - The operation of changing tubes is not very difficult, but it requires the use of a rather expensive wrench which is not ordinarily supplied with the unit. This wrench is used for removal of the end caps of the casing. To change the tube, proceed as follows:

Tilt the tube head so that the oil plug is up. Remove the plug, turn the head over and pour the oil into a container that is absolutely *clean and dry*.

Unscrew both of the end caps with the special wrench which fits into the four holes in each end cap. Disconnect the filament leads of the x-ray tube from the studs to which they are attached. Remove the large nut from the anode stem of the tube and loosen the screw which clamps the anode stem, using the special wrench that is supplied with the unit. Remove the x-ray tube. Insert the new x-ray tube and hold it tight against the shoulder of the anode support. Now rotate the tube so that the target points toward the window, and clamp it in place with the special screw. Put the large nut on the end of the tube anode. Connect up the filament leads.

Before tightening the special screws which lock the anode shank, look through the tube window that is in the tube head to make sure that the focal spot is in the exact center of your window, and that it points directly toward the window. Then tighten the anode shank firmly in place. Replace the end cap which does not have the oil plug hole.

Turn the head so that the open end is up, and fill it about three-fourths full of *clean* oil. Replace the other end cap and complete filling the head with oil. Replace the oil plug.

This filling with oil has not yet removed the air which is trapped inside the bellows, or the air which may be trapped inside the two ends of the x-ray tube. To remove this trapped air, turn the head so that the bellows points downward. Remove the bellows housing which is held in place by four screws and compress the bellows slightly. Then release the pressure on the bellows.

This pumping of the bellows forces the air out of the bellows, and allows the oil which is in the housing to flow into the bellows. It also pumps the air out of the ends of the x-ray tube. This pumping of the bellows should be repeated several times. Then the tube head should be turned so that the oil plug is up and the housing should be filled full of oil.

Any sound of gurgling inside of the tube head will be an indication that there is an air bubble inside the casing, and that the oil plug should be removed to allow this air bubble to escape.

Replace the bellows housing and adjust the oil supply inside the tube as described before.

DOUBLE FOCUS TUBE - To remove the end cap of the tube head which contains

MODEL "E-60" SHOCKPROOF MOBILE UNIT

the double focus tube, remove the screw which is in the center of the focal spot changing switch that is on one end of the cap. Pull the knob off.

Remove the three screws which hold the scale in position, and lift the scale out. The holes used for unscrewing the cap are under this scale. Remove this end cap.

The switch unit must be removed before the x-ray tube can be removed. This can be done by taking out the two screws which attach it to the metal brackets on the high-tension post.

The parts which have been removed must be re-assembled in the reverse order to that outlined above.

The x-ray tube should be lined up and tightened in place just as described for the single focus tube.

CAUTION - In handling the switch unit, be careful not to disturb the small coil of wire that is on the switch. If this coil is disturbed so that some of its turns become short-circuited, the filament current on the small focal spot may be made unsteady. It is, therefore essential that all of the turns of wire in this coil be carefully spaced from each other.

Be careful of the filament leads on the x-ray tube. They are easily broken off and are almost impossible to repair.

SHOCKPROOF CABLES - The shockproof cables used on this tube head are made of the finest material available at any price at the present time. The insulating material is a special synthetic rubber compound developed for high-voltage insulation. This material is almost unaffected by oil, but it is weakened by excessive bending.

Maximum life will, therefore, be obtained from these cables if reasonable care is exercised in the use of the tube head to avoid bending or twisting these cables unnecessarily. Special care should be exercised to prevent this cable from being sharply bent, especially while the x-rays are turned on.

MODEL "E-60" SHOCKPROOF MOBILE UNIT

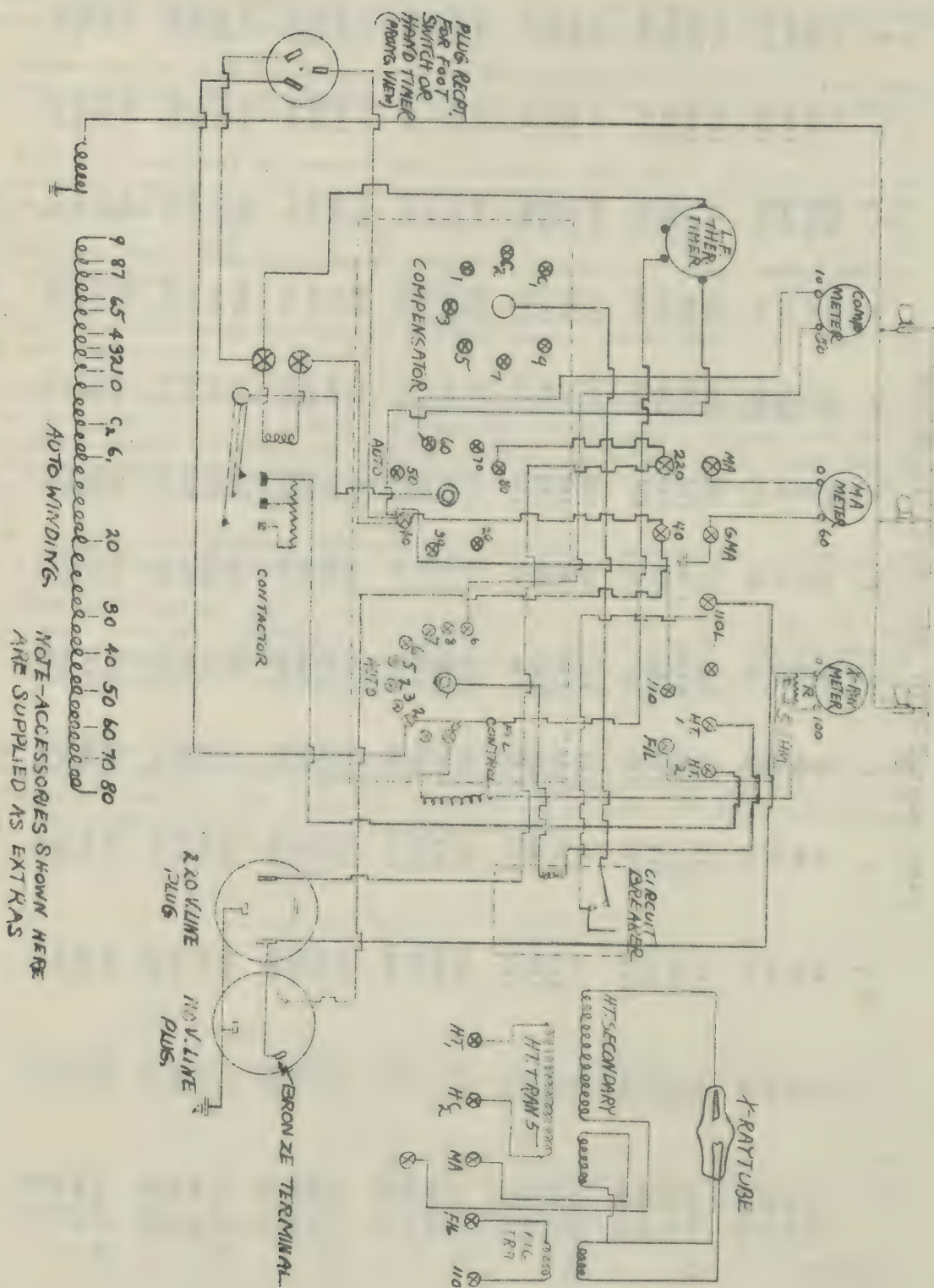
E-60 MOBILE AUTO 50 - 60 Cycle 99 PKV.

TAP	C-1	C-2	0	1	2	3	4	5	6	7	8	9
30 turns	83	88	90	93	95	98	100	103	105	108	110	113
10 MA	77	82	84	86	88	91	93	96	98	101	103	105
30 MA	80	85	87	90	92	95	97	100	102	104	106	109
50 MA	83	88	90	93	95	98	100	103	105	108	110	113
40 turns	108	113	115	118	120	123	125	128	130	133	135	138
10 MA	101	105	107	110	112	114	117	119	121	124	126	129
30 MA	104	109	111	114	116	119	121	124	126	129	131	134
50 MA	108	113	115	118	120	123	125	128	130	133	135	138
50 turns	133	138	140	143	145	148	150	153	155	158	160	163
10 MA	124	129	131	133	135	138	140	142	144	147	149	152
30 MA	129	134	136	138	140	143	145	148	150	153	155	158
50 MA	133	138	140	143	145	148	150	153	155	158	160	163
60 turns	158	163	165	168	170	173	175	178	180	183	185	188
10 MA	147	152	154	156	158	161	163	166	168	170	172	175
30 MA	153	158	160	163	165	167	169	172	174	177	179	182
50 MA	158	163	165	168	170	173	175	178	180	183	185	188
70 turns	183	188	190	193	195	198	200	203	205	208	210	213
10 MA	170	175	177	180	182	184	186	189	191	194	196	198
30 MA	177	182	184	187	189	191	193	196	198	201	203	206
50 MA	183	188	190	193	195	198	200	203	205	208	210	213
80 turns	208	213	215	218	220	223	225	228	230	233	235	238
10 MA	194	198	200	203	205	208	210	212	214	217	219	222
30 MA	201	206	208	211	213	216	218	221	223	226	228	230
50 MA	208	213	215	218	220	223	225	228	230	233	235	238
90 turns	233	238	240	243	245	248	250	253	255	258	260	263
10 MA	217	222	224	226	228	231	233	236	238	240	242	245
30 MA	226	230	232	235	237	240	242	245	247	250	252	254
50 MA	233	238	240	243	245	248	250	253	255	258	260	263

Compensator meter calibration 10 MA = 175 V., 30 MA = 182 V., 50 MA = 188 V.
Compensator meter connected to auto studs #60 and #9.

E-144

MODEL "E-60" SHOCKPROOF MOBILE UNIT



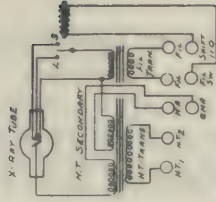
SPEC NO. WIRING DIAGRAM FOR MODEL "E-60" MOBILE UNIT

SECTION XXXVIII

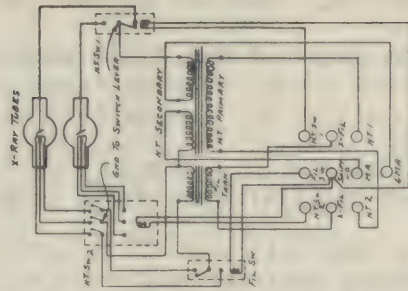
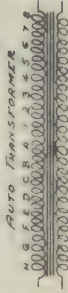
STANDARD 100 MA UNIT

TO A MACHINE

TO A MACHINE



W.D For "E" TRANSFORMER



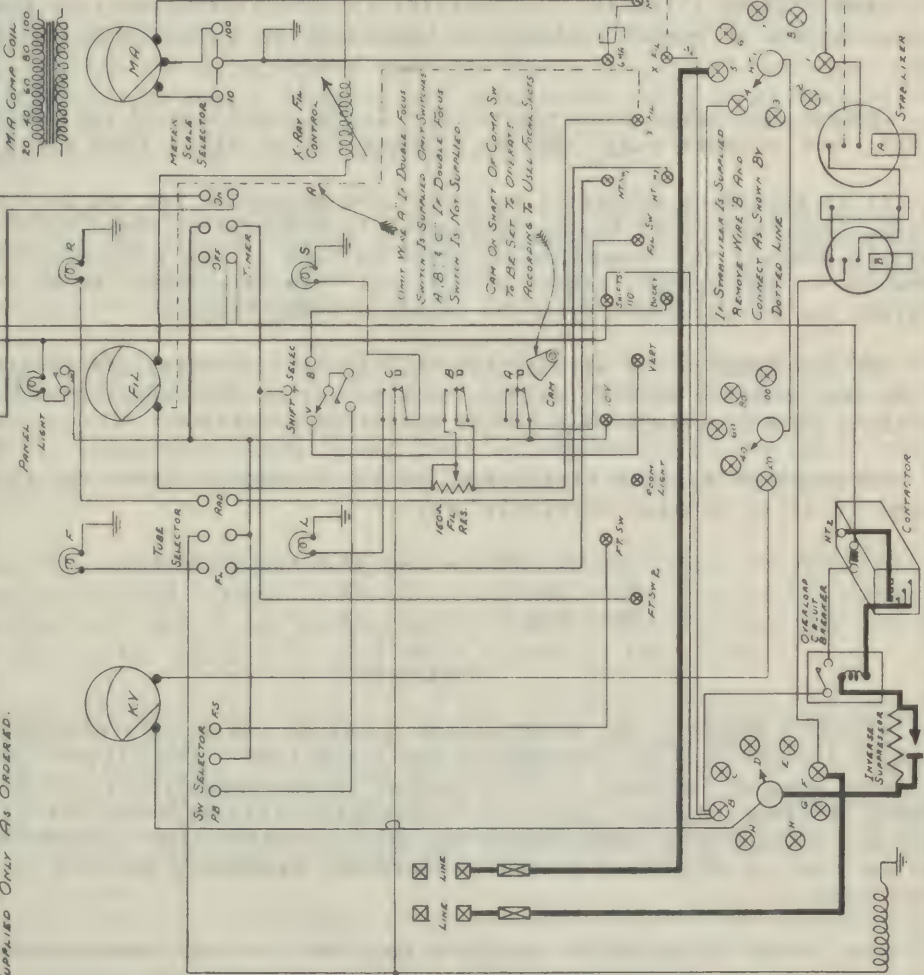
W.D. For "E-2WAY" H.T. TRANSFORMER



ROOM LIGHT FOOT SWITCH

STANDARD X-RAY CO.	SALEN E. K. G.	SCALE	NONE
	CH'D	DATE	5-4-42
	CHARGED <i>1000</i>	DATE	02.9
A			
B			
C			
D			
E			
F			

A-946 M



WIRING DIAGRAM FOR E-100 MOBILE CONTROL

STANDARD 100 MA UNIT

STANDARD TYPE E-100 MACHINE

INSTRUCTIONS FOR ASSEMBLING AND OPERATING

UNPACKING - The Standard Type E-100 Machine is shipped in two units.

1. control stand
2. high tension unit.

Any crates which arrive in a damaged condition should be reported immediately to the carrier. Open the crates carefully to prevent damage to fragile contents.

Examine packing material carefully to prevent loss of small articles. Do not throw any of the packing material away until all articles have been accounted for, and the machine properly assembled. Any damage to contents should be reported immediately to the carrier and to the factory.

ASSEMBLY - Place the control stand and the high tension unit in the positions they are to occupy. Connect the control unit and the high tension unit together by means of the heavy cable, making sure that all connections are made tight, and that the labels on the wires correspond with the labels on the studs to which they are connected.

LINE VOLTAGE - The line cable wires should be attached to a source of alternating current of proper voltage and frequency, as indicated by the generator name plate.

Connect the cable wires marked "LL" to the terminals of your main line service switch, and connect wire "GR" to a waterpipe or other good electrical ground.

If it should be necessary to adjust the generator for use on a much different voltage from that shown by the nameplate, this should be noted on the nameplate in order to prevent the damage which might be done if the generator should later be connected to an improper source of current. New nameplates, which we will mark as ordered, can be purchased from the Standard X-Ray Company.

SERVICE WIRES - For work at 100 MA, the service wires and the transformer out on the pole must be able to deliver 50 amperes, at 220 volts, to the x-ray machine terminals with a voltage drop of not more than 8 volts.

Recommended service wire sizes, at the following distances from Pole Transformer to x-ray machine terminals are:

0 - 50 Ft.	- Use #4 Wires or larger
50 - 150 "	- " #2 " " "
150 - 200 "	- " #0 " " "

METERS

KILOVOLT METER - The penetrating power of the x-rays produced depends upon the high tension voltage supplied to the x-ray tube. The kilovolt meter indicates this high tension voltage; it is connected in the primary circuit and measures the primary voltage. Since there is a definite ratio between the primary and the secondary voltage of a transformer, the meter is calibrated to read the high tension voltage that is delivered by the transformer secondary and the rectifier to the x-ray tube.

This meter is accurate within a very few per cent when operated at 30 MA. Slight variations, due to differences in x-ray tubes and to higher or lower milli-

STANDARD 100 MA UNIT

amperage may be expected.

FILAMENT AMMETER - This meter actually measures the primary current in the filament transformer. It is calibrated with an arbitrary scale arranged for easy reading. When a new tube is installed, determine the settings of this meter which give you the milliamperes desired. Record them. These settings can then be used for pre-setting the milliamperes on future exposures, thereby eliminating the necessity for testing the milliamperes for each new exposure. This will assist you materially in obtaining long life from your x-ray tube.

MILLIAMPERE METER - This meter is a "ground circuit" milliamperemeter that is connected in the middle of the high tension transformer secondary winding. It measures the high tension current in the x-ray tube directly.

The two scales on the meter are controlled by the "high-low" switch near the meter. Setting this switch to "high" causes the meter to read on the 0-100 MA scale. Setting this switch to "low" causes the meter to read on the 0-10 MA scale.

CAUTION - Be sure always that you are reading the correct scale on the meter. A glance at the "high-low" switch will tell you which scale to read. An error in reading your milliamperemeter may cause you to waste a film due to making a radiograph with only 1/10th the milliamperes that you should use; or it may cause you to ruin an x-ray tube if you make a fluoroscopic examination using 50 MA instead of 5. Your attention is called to this danger because such things have happened on other high power apparatus in which double scale meters are used.

X-RAY FILAMENT PRIMARY AMMETER - This meter is supplied for use especially in radiography, for the pre-setting of filament current to give the desired milliamperes. This meter measures the primary current of the x-ray filament transformer. It is provided with an evenly divided arbitrary scale for easy reading.

An adjustable shunt on the back of this meter permits adjustment of the meter scale to suit the characteristics of your x-ray tube or tubes. The shunt can be set so that this meter will read at the lower end of its scale on fluoroscopy, and at the higher end of its scale for radiography. Such an adjustment of the meter enables the operator to pre-set the x-ray filament current to obtain the desired milliamperes.

To adjust the shunt, set the auto controls to deliver about 50 PKV. Set the capacity selector and the filament controller to obtain the highest milliamperage that the operator will use in his radiographic work. Adjust the shunt on the back of the meter so that the meter will read about ninety on its scale.

Next, adjust the capacity selector and the filament controller to bring the milliamperes down to about five. The meter now should read somewhere near the lower end of its scale. If it does, no further adjustment is necessary. If it reads too high or does not read at all, the zero adjuster on the meter can be turned to give a desirable reading. The setting for high milliamperage should then be checked again. If necessary, re-adjust the shunt to give a desirable high reading.

Greatest accuracy will be obtained in pre-setting for desired milliamperes if the meter is adjusted so that as much as possible of the meter scale is used to make the various filament settings.

STANDARD 100 MA UNIT

GENERATOR CONTROLS

LINE SWITCH - The line switch controls the fuses and all of the circuits in the generator. It is closed by lifting the line control knob as far as it will go. This should cause the kilovolt meter and the filament meter to read, and the filament of the x-ray tube to light up.

FILAMENT CONTROL - Regulation of the milliamperes is obtained by changing the temperature of the filament of the x-ray tube. This is accomplished by turning the handle on the filament controller in a clockwise direction to increase, or in a counter-clockwise direction to decrease the milliamperage.

AUTO CONTROLS - Regulation of the high tension voltage is accomplished by the left-hand auto control to vary the kilovoltage in major steps, and the right hand control in minor steps.

MILLIAMPERE COMPENSATOR - This controller adjusts the kilovolt meter reading to correspond with the actual peak kilovolts that will be delivered to the x-ray tube at the various milliamperages that may be used. Example: For 5, 10, 15 or 20 MA, the compensator should be set on the 0-20 range; for 100 MA, set the compensator on 80 to 100.

SWITCH SELECTOR - When this switch is turned to "F.S.", the foot switch alone will control the x-ray exposures if the Timer Switch is "off". If the timer switch is turned "on", the foot switch will control the exposures through the motor driven timer.

Turning the switch selector to "PB" connects up the Shifts Selector switch.

SHIFTS SELECTOR - When the "shifts" control knob is turned to "Vert.", depressing the push button will energize a stereo release coil, if it is properly attached to the studs on the control panel.

When the control knob is turned to "Timer", depressing the push button will turn on x-rays and keep them turned on as long as the button remains depressed, if the "Timer" switch is turned "off". If the "Timer" switch is turned on, the Shifts push button will control the x-ray exposures through the motor driven timer.

When the Shifts control knob is turned to Bucky, depressing the Shifts push button will operate the Bucky release mechanism. The Bucky timing device will control the length of the x-ray exposures directly if the Timer switch is turned "off". If the Timer switch is turned "on" - the Bucky will control the x-ray exposure through the motor driven timer. (The Bucky must be set for a slightly longer exposure than the timer). Releasing the push button before the end of the exposure will interrupt the exposure.

TIMER SWITCH - When the timer switch is turned "off", the length of the x-ray exposure will be governed directly by the push button or foot switch or Bucky Diaphragm.

When the timer switch is turned "on", the length of the x-ray exposure will be governed by the motor driven timer. Removal of pressure from the foot switch or push button will enable you to interrupt the x-ray exposure at any time.

OVERLOAD CIRCUIT BREAKER - The coil inside this breaker is connected in series with the high tension transformer primary winding. Any overload in the high tension transformer will cause this switch to open the primary circuit. The quantity of high tension current that may be used without causing the breaker to

STANDARD 100 MA UNIT

operate is governed by the small knob and pointer at the bottom of the breaker. Turning this knob to the right increases, and turning to the left decreases the amount of high tension current which may be used. For maximum protection, the pointer should be set as "low" as possible without causing the breaker to act.

CAUTION - Before operating the machine, be sure to remove the vent screw which is in the center of the oil plug. Inspect the oil level in the high tension transformer. If it is more than 1/2 inch from the cover, add transformer oil to bring the oil up to this level.

LINE VOLTAGE ADJUSTMENT - This adjustment must be made once - at the time of installation. It need not be made again unless the power company changes the voltage of its lines.

Close the "Line" Switch by lifting it up as far as it will go. This should cause the kilovolt meter to read and the x-ray filament to light up.

Adjust the auto controls to "H" and 8, and turn the milliamperage adjuster to the word "To" between 80 and 100. The kilovolt meter should now read 85.

If it reads less than 85, remove the back panel of the control stand and shift the line voltage adjuster wire, which is the heavy wire that is now attached to a numbered stud on top of the auto control board, to a lower numbered stud. Make your connections tight.

If the kilovolt meter reads too high, shift the line voltage adjuster wire to a higher numbered stud.

These generators are adjusted at the factory for operation on 220 volts unless ordered for some other voltage. This voltage is shown on the control stand nameplate.

Adjustment for other voltages can be made by shifting the two line voltage adjuster wires to the auto studs which correspond to your line voltage, as shown by the auto transformer voltage table on sketch A-946M. These line voltage adjuster wires are the two heavy wires which run from the fuses to one of the lettered studs and one of the numbered studs on the auto control board.

INSTRUCTIONS FOR CONNECTING STANDARD TAPPED FILAMENT STABILIZER

This Stabilizer is designed for operation on 200-230 volt, 50 - 60 cycle, A.C.

CONNECTING UP - If supplied separately (not as an integral part of the machine) remove the cover on the Stabilizer and connect the "common" binding post and the '220 volt' binding post to a source of 220 volt, alternating current. The number of cycles per second delivered by this alternating current source must correspond with the frequency shown on the Stabilizer nameplate.

Connect one terminal of the filament control to the "common" binding post, and connect the other terminal of the filament control to one of the primary terminals of the filament transformer. Connect the other primary terminal of the filament transformer to the Stabilizer binding post which gives the best operation of the x-ray filament controller.

OUTPUT VOLTAGES - When properly connected, the stabilized voltages obtained from the numbered studs will be approximately as follows:

STANDARD 100 MA UNIT

STUD	1	2	3	4	5	6	7	8	9
Com.	74V	88V	96V	108V	120V	132V	145V	158V	169V

The filament transformer should be attached to the lowest voltage stud that will permit the x-ray tube to be operated at its maximum desired milliamperage. No adjustment is necessary if the stabilizer is supplied as a part of the machine.

NOTE - If the filament controller is located in the control stand in the x-ray machine, it is probably inter-connected with some of the other circuits in the control stand. Therefore, before connecting the filament controller to the Stabilizer, the controller should be disconnected from anything that it is now connected to and the controller wires run directly to the Stabilizer. This instruction also holds true for the filament transformer.

If the milliamperes are found to be unsteady after the Stabilizer is connected up, the trouble will be caused either by some error in making the above connections, or by a loose connection somewhere in the filament transformer circuit, such a loose connection being most likely to occur in the wiring which connects the filament transformer to the x-ray tube.

OPERATION

Close the Line Switch.

Adjust the Auto Controls to the desired kilovoltage, as shown by the kilovolt meter.

Adjust the filament controller to give the filament meter reading required for the desired milliamperes.

Make certain that the correct tube and focal spot are in use.

Close the circuit breaker switch and set the pointer as low as possible without causing the breaker to act.

Turn on x-rays.

Adjust milliamperes to the desired value.

FLUOROSCOPY

If the foot switch is not located convenient to the control stand, the fluoroscopic milliamperage may be checked and adjusted as follows:

Turn the Switch Selector to PB.

Turn the Shifts Selector to "Timer".

Turn the Timer Switch to "off".

and turn on x-rays by means of the "Shifts" Push Button.

For Fluoroscopic Work -

Turn the Switch Selector to "F.S."

Turn the "Timer" switch to "off".

RADIOGRAPHY

With Motor Driven Timer -

Turn the Switch Selector to "F.S." or "P.B." as desired.

Turn the Shifts Selector to "Timer".

Turn the Timer switch "on" and adjust the timer for the desired exposure time.

Use either the foot switch or the push button, and turn on x-rays.

With Bucky Alone

Turn the Switch Selector to P.B.

Turn the Shifts selector to Bucky.

Turn the "Timer" switch to "off".

STANDARD 100 MA UNIT

Turn on x-rays with the shifts push button, and remember to keep the push button depressed until the exposure is finished.

With Bucky & Motor Driven Timer

Turn the Switch Selector to P.B.

Turn the Shifts selector to Bucky.

Turn the "Timer" switch to "on".

Adjust the timer for the desired exposure.

Adjust the Bucky for a slightly longer time.

Use the shifts push button to release the Bucky, and turn on the x-rays.

Keep the push button depressed until the x-ray exposure is finished.

RATING CHART - UNRECTIFIED

STANDARD MODEL "E" OIL IMMERSSED SHOCKPROOF X-RAY
TUBE UNIT WHEN USED WITH UNRECTIFIED GENERATORS

NOTE - Do not operate the tube at more than 90 PKV unless your generator is equipped with an inverse suppressor. **BE SURE - DON'T BE SORRY.**

RATING CHARTS - The times shown on the chart indicate the maximum exposures the tube can stand when the anode is cold. If the tube anode is not cold, either wait for it to cool off or reduce the exposure. The tube is assumed to be 'cold' when the shockproof casing is not uncomfortably warm to your touch, and when the tube has had two minutes in which to cool off following the last exposure.

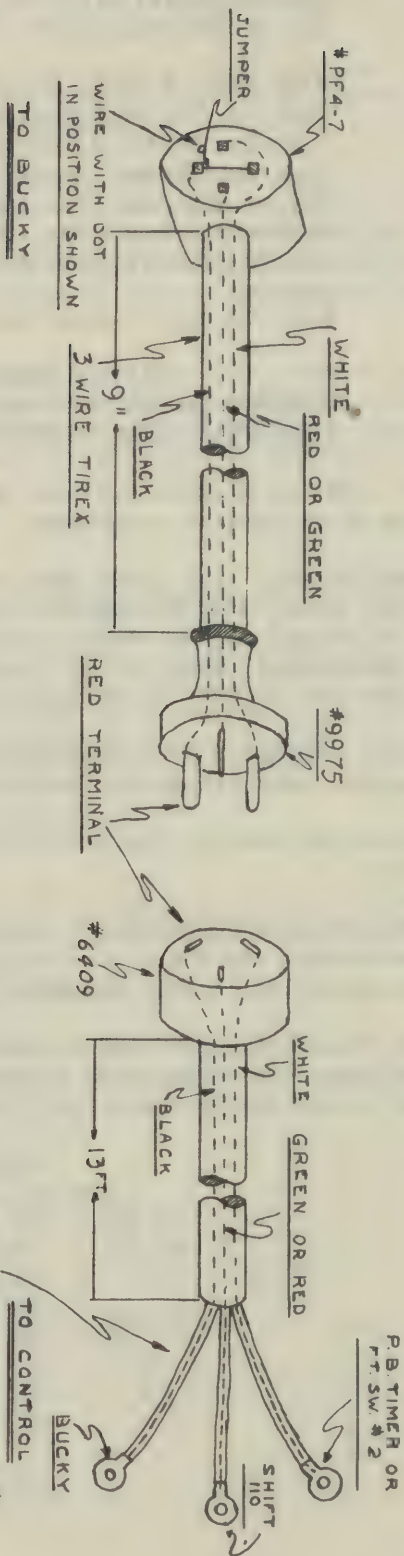
The two exposures of a stereoscopic pair should be added together and considered as one exposure which should not exceed the tube rating.

Two minutes cooling time must be allowed the tube between successive heavy exposures.

A long series of fluoroscopic examinations or radiographic exposures may prove sufficient to heat the tube case to a temperature that is uncomfortable to touch. When this occurs, the outfit should be allowed to cool off.

Watch the milliamperere meter, especially on long or heavy exposures. A sudden rise in milliamperes during such an exposure indicates overheating of the tube and warns that x-rays must be turned off immediately.

RATINGS				
(3.8 mm)		Focal	Spot	
50 MA	90	PKV	10	Sec.
60 MA	90	"	3½	Sec.
"	80	"	7	"
"	70	"	15	"
75 MA	90	PKV	1/2	Sec.
"	80	"	1	"
"	70	"	3	"
"	60	"	10	"



NOTE:

PLUGS NO. 9975 AND 6409 ARE HUBBELS. NO. PF4-7 IS AMERICAN PHENOLIC.

BUCKY CABLE FOR MODEL "E-100" TILT TABLE

SECTION XXXIX

100 MA CONTROL - P -

SECTION XXIX

100 MA CONTROL - P -

100 MA CONTROL (P)

1. GENERAL INSTRUCTIONS AND SUGGESTIONS - After the unit has been unpacked, a careful check should be made with the packing slip and the parts of the unit to be absolutely certain that no parts have been left in any of the packing cases.
2. Every care is exercised in the packing of this equipment to insure safe arrival. All finished parts are protected with heavy wrapping of wax paper to prevent abrasion of painted surfaces.
3. If shortages occur they must be reported immediately. If the equipment shows any signs of external injury, the crates should be examined and the incident should be reported to the carrier, filing claim for the damage done.
4. ATTACHING TRANSFORMER AND CONTROL CABLES AND GROUND WIRES - Remove rear door by unscrewing four self tapping screws. It will be noticed that a wiring diagram for this individual unit is pasted on the inside of this door. Next remove the two cable clamps on the lower left of the terminal panel.
5. Now first connect the line cable in the manner shown on diagram #2 clamping the cable in the extreme left clamp and putting the cable through the left hole on the fibre strip at the bottom of control. Since this cable is of small diameter it is necessary to clamp it around the spinning.
6. Now install the control to transformer cable (this is the multiwire cable) according to the diagram #2 and put each lug on the corresponding number on the terminal panel. Then clamp the cable by the remaining clamp alongside the line cable. There is a red tag on cable indicating which is the control end. Also be sure to put cable through center hole on the fibre cable retaining strip.
7. Be sure none of the lugs are digging into any of the control wiring, and also that they are clear of other lugs. In order to give the installation a better appearance, the single wires can be tied or taped together at various appropriate spots.
8. It will be noticed that there is a jumper on the terminal panel for stud 10 to stud 13. This must be removed if double focus tubes are used.
9. There are also two leads, 19 and 20, which are used in conjunction with a motor drive transformer. If a motor drive is not used then these lugs can be cut off and taped up.
10. The unconnected end of the line cable is unfinished so that it may be cut off to any desired length. Lugs are supplied (tied onto the cable) which may be soldered on to the cable so as to attach line cable to incoming line.
11. With control in desired position place control to transformer cable along desired route to the transformer, either along the floor or in conduit, dependent upon installation conditions. Remove cover casting from transformer and connect corresponding numbers on cable to the corresponding transformer studs. The cable is split into a "V" at this end, thus each leg of the "V" is clamped under the two adjacent clamps. The cable is then bent around and again clamped at the edge of the transformer.
12. Studs 4, 19 and 20 are not connected to anything and are just dummy studs. They are utilized when the transformer incorporates a motor drive and then the leads come from the motor to these studs. If a motor drive is not used, lugs 4, 19 and 20 in the control to transformer cable may be cut off and taped up, or, of course, both the studs and spare cable leads can be utilized to any additional purpose you may desire.

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13. **STABILIZER** - Provisions are made for the installation of a filament stabilizer to this unit. To install stabilizer mount unit on base in front of the control, the four 1/4-20 studs protruding through the feet on the stabilizer base. Lock down by 1/4-20 nuts.

14. Separate the male and female plugs (to be seen hanging down from two cords below the auto transformer) which normally are joined together when control does not incorporate a stabilizer, and plug into the male and female receptacles on the stabilizer.

15. **RF CHANGEOVER** - If unit calls for an RF changeover, this should be mounted on the base of the control but at the rear with the controls accessible from the rear. The bracket is first mounted by the four nuts and bolts to the base with the primary cables going through bracket and up around the back. The RF changeover is then bolted on top of the bracket with the filament control out to the rear.

16. The radiographic checkswitch which is attached to the end of the cable of the RF changeover is mounted in the hole provided for it at the upper right hand side of the control alongside the push button. It will be necessary to remove the control front panel to do this.

17. A wiring diagram of the unit is attached to the RF changeover. However the control wiring diagram should be consulted. This indicates that a jumper should be installed between PB-2 and 17, and jumper 21 to 22, 13 to 17, and 5 to 26 must be removed. Connect the cable to the terminal board by means of the lugs. These lugs are lettered and the corresponding numbers to which they are to be connected can be read from the main wiring diagram. It is also necessary to remove the radiographic and fluoroscopic resistance adjusters on the 75 ohm limiting resistor. This resistor is the top one of a bank of four resistors mounted at the left front of the autotransformer and must be reached from the front of the control. This resistor can readily be distinguished since the other three resistors are of high resistance values and are wound with fine wire. The switch marked "Exp. On & Off" which is mounted on the control panel has one of its leads going to the coil of relay #1. This can be seen on the wiring diagram. The lead must be removed from the coil of relay 1 and connected to stud 9 on the terminal panel. The footswitch which normally connects to studs 24 and 25 must now be connected to S-1 and S-2 on the RF changeover panel and likewise the two leads from the 1704 spot film device must be connected to S-5 and S-6 on the same panel.

18. **KILOVOLT & X-RAY FILAMENT METER** - The meter #1, Fig. 1, is a combination x-ray filament meter and kilovoltmeter calibrated directly in kilovolts in three ranges. For milliamperages from 5 to 40 use the scale marked 30 M.A., for milliamperages of 175 to 200 use the scale marked 200 M.A. For intermediate milliamperages it will be necessary to interpolate between the three scales. The kilovoltmeter is calibrated to read at the indicated values with load on. In series with the kilovoltmeter will be found two adjustable 10,000 ohm resistors which can be adjusted to change the kilovoltmeter reading. The more resistance inserted the lower the kilovoltmeter will read. This way the KV output can be increased. Likewise, if resistance is taken out, the KV meter will read higher, and thus the KV output will be lowered. These resistors are set correctly according to calibrations taken at the factory. However, a slight change may be indicated as necessary in some installations. A calibration of the unit should be made before changing their values. These two resistors are located in a bank of four similar resistors mounted alongside of the left front of the autotransformer and are tagged so as to be readily identified.

19. **FILAMENT METER SWITCH** - Switch #5, Figure 1, is a two-position, self-returning switch, which normally connects the kilovoltmeter in the circuit all of the

time. However, when the switch is operated, it automatically disconnects the kilovoltmeter and automatically connects the x-ray filament meter in the circuit as long as the switch is held with the finger. Releasing it, it automatically returns so as to connect the kilovoltmeter. This x-ray filament meter is a pre-reading meter and should be calibrated by the serviceman when making the installation. A blank calibration chart for this purpose is included in the back of this section. It is suggested that the pre-reading (before exposure) values of the x-ray filament meter be recorded for several milliamperages chosen by the doctor in charge at several kilovoltages with **THE PARTICULAR X-RAY TUBE TO BE USED**. Whenever a new tube is used, these values should be rechecked and changed if necessary. The full scale deflection of this meter is 80 volts, and since the filament supply is above this value an adjustable 10,000 ohm resistor is incorporated in series with the movement so as to be able to keep the pointer on scale. If too much resistance is inserted, the actual filament readings will read too low when the tube is connected for actual operation.

20. **MILLIAMMETER** - No. 2, Figure 1, is an AC milliammeter with a double scale covering the entire range of the machine. It indicates the current passing through the x-ray tube which is controlled by the filament control #11.

21. **FOCUS AND VALVE TUBE CHANGE SWITCH** - The switch #16 selects the focus of a double focus x-ray tube, and at the same time inserts the small focus limiting resistor in the circuit. This is set so as not to obtain more than 45 M.A. on the small focus setting. In the case of a single focus tube it just inserts the aforementioned limiting resistance so as not to obtain more than 45 M.A. on the small focus setting with the tube on the same focus of course. It will be noticed that this switch also closes relay #1 on the small focus setting, which automatically lowers the valve tube voltage by inserting more of the three ohm valve tube adjusting resistor, which is mounted at the right rear of the control hanging from the autotransformer support brackets.

22. **MILLIAMMETER RANGE CHANGE SWITCH** - Switch #6 changes the scale on the milliammeter. When this switch is on "low", the milliammeter is on the 0 to 40 M.A. scale and at the same time a green light is energized to serve as a visual indication. This light illuminates only the lower portion of the scale so as to provide the minimum of light interference for fluoroscopy and yet the meter can easily be read at these low values.

23. **LIGHT SWITCH** - Switch #4 operates the lights in the control which illuminate both the meters and the timer dial (if the square synchronous timer is in the control) with a white light to facilitate reading these instruments.

24. **BUCKY RELEASE SWITCH** - The control has incorporated a bucky release switch (#5 on Figure 1). If the timing is to be done by the bucky, the bucky leads should be connected as in the wiring diagram (magnetic release leads to studs 3 and 4, and contact device leads to studs 2 and 2A). Then by cocking the bucky and setting the bucky dial to the desired exposure time, exposure can be obtained by depressing this bucky release switch on the control panel.

25. If it is desired to do the timing in conjunction with the bucky by the synchronous timer in the control, then the bucky coil should be connected to 36 and 51 on the control terminal panel in the case of a 929-B timer or to 36 and B on the timer panel of a 914 timer. The bucky contact device leads are not used in both of these latter cases. In this connection the bucky is cocked and the bucky dial is set for the desired time and likewise the timer is set for the same time. Then the timer push button is depressed. This releases the bucky and the timer starts and also times the exposure.

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26. **TIMER SWITCH** - Switch #7, Figure 1, is for operation of the timer #8, Figure 1. We recommend that this switch remain in the "OFF" position except when the timer is being used in order to prevent unnecessary wear to the bearing of the timer mechanism.

27. **MAIN SWITCH** - Switch #9, Figure 1, is the main switch, which is, of course, in series with the incoming line. This switch should be in the "OFF" position when the control is not in use. Otherwise the autotransformer will consume a small amount of current from the line when it is unnecessary.

28. **CIRCUIT BREAKER** - Knob #14, Figure 1, is the circuit breaker reset button. This circuit breaker has been set at the factory to open at milliamperages over 200. If it is desired, this setting can be changed by raising or lowering the adjusting screw on the bottom of the circuit breaker, inside of the "RT" control. It is a double toggle safety type breaker, and will open the circuit on overloads even though the knob be held or tied down.

29. **M.A. AND FOCUS SWITCH INTERCONNECTION** - There is a slotted tie bar connecting the focus and M.A. switch so that they cannot be operated independently. This way when the focus switch is on "Small Focus" the M.A. meter is always on the low scale, and with the focus switch set on "Large Focus" the M.A. meter is then on the high scale. This slotted tie bar can be slid off these switch handles if independent operation of the focus and M.A. switches is desired. However, more protection is obtained with the tie bar left on.

30. **X-RAY FILAMENT REGULATOR & FILAMENT LIMITING RESISTORS** - No. 11, Figure 1, is the x-ray filament regulator. This is connected in series with a 75 ohm, 160 watt semi-variable resistor mounted at the left front of the control hanging down from the autotransformer support straps. With the control set on large focus this resistor should be so adjusted that the maximum desirable milliamperage is obtained with the filament regulator turned as far to the right as possible (a little leeway, of course, should be allowed). In this manner the regulation of the filament control will be much finer in that any change of the control knob will cause a minimum of change in the x-ray filament current. This will also result in limiting the x-ray tube milliamperages so that accidental overloads beyond the control rating of 200 M.A. should not occur.

31. There is an additional filament limiting resistance which is in only when the focus switch is set on "Small Focus". This is a 75 ohm, 75 watt resistor which is mounted as the top unit of a bank of four resistors, seen at the left front of the autotransformer. The resistor has three adjustable straps, two in the center and one a shorting strap from the end; this latter strap is normally set at the end of the resistor so as to put all of the resistance in. Of the other two taps one is a "rad" tap to be adjusted so as to obtain no more than 40 M.A. with filament regulator turned all the way up and focus switch set on "Small Focus". The other tap is the "fluo" tap and is to be adjusted so that no more than 7 or 8 M.A. can be obtained with filament regulator turned all the way up, and with the focus switch set at "Small Focus", the exposure switch set "On", and the exposure obtained by the footswitch, the latter being connected to 24 and 25.

32. With an RF changeover added the "Rad" and "Fluo" adjusters are removed and the end strap on this resistor must be moved so as to obtain no more than 40 M.A. with the focus switch set on "Small Focus".

33. **FLUOROSCOPIC LIMITING DEVICE** - The control incorporates a fluoroscopic limiting device. This device guards against any high milliamperage exposure by means

of the footswitch even though the filament control is set to a high radiographic M.A. In order to get exposure by the footswitch (connected to studs 24 and 25), the exposure switch must be "on", and the focus switch on "Small Focus". The maximum M.A. is set around 7 M.A. with filament regulator turned all the way up. This is done by adjusting the "fluo" adjuster on the 75 ohm, 75 watt limiting resistor as discussed in paragraph #31. When the footswitch is not in use the exposure switch must be turned off.

34. RADIOGRAPHIC-FLUOROSCOPIC CHANGEOVER OPERATION - Essentially this attachment serves to change over the machine from fluoroscopic settings to radiographic settings when the spot film device is tripped or shifted from the fluoroscopic to the radiographic position or vice versa. This apparatus serves as a means to quickly make these necessary adjustments on the apparatus compared to the lengthy procedure of making the changeover manually.

35. In changing from fluoroscopy to radiography the relays in the R-F changeover serve to change the filament setting by changing from one filament control to another, change the scale of the milliammeter, and change the operation of the footswitch from continuous exposure (as long as depressed) on fluoroscopy to timed exposure through the timer on radiography. When double focus tubes are used, the changeover will change focal spots simultaneously with the change of filament controls. The fluoroscopic filament control is a variable rheostat incorporated in the R-F changeover, on which a dial is mounted for ease of adjustment. This is set for the desired milliamperage for fluoroscopy and is left in this position for all fluoroscopic work. It, of course, may be adjusted at any time by removing the rear of the control cabinet which gives access to the control knob.

36. In the interior of the R-F changeover cabinet there is a 75 ohm limiting resistance which is in series with the fluoroscopic filament control. This is adjusted so that the desired M.A. range can be obtained by the fluoroscopic filament control and also that too great an M.A. is not obtained if fluoroscopic filament control is accidentally turned too high. This is set at the factory and should need no further adjustment.

37. In operating the unit the spot film device should be set in the fluoroscopic position, and the radiographic setting should be made on the control by holding down the convenience switch on the side of the control and the radiographic setting made by adjusting the filament control. It is presumed that the fluoroscopic filament control in the attachment has already been adjusted to the proper value on installation. The timer should be adjusted to the proper value for the radiographic exposure at the same time the radiographic setting of filament current is set. The footswitch will now control both the fluoroscopic and radiographic exposures so that the machine may be controlled entirely at the table. With the spot film device in the fluoroscopic position, depressing the footswitch will give a continuous fluoroscopic milliamperage. If the spot film device is tripped, the changeover will function and the footswitch will operate the timer for a radiographic exposure as previously set on the machine.

38. A RADIOGRAPHIC EXPOSURE SHOULD NOT BE MADE BY HOLDING DOWN THE FOOTSWITCH AND TRIPPING THE SPOT FILM DEVICE SINCE THIS WILL PROBABLY GIVE A POOR RADIOGRAPH DUE TO MOVEMENT OF THE FILM DURING THE EXPOSURE. IT IS USUALLY BEST TO WAIT ABOUT THREE SECONDS AFTER THE DEVICE IS TRIPPED BEFORE AGAIN PRESSING ON THE FOOTSWITCH TO MAKE THE RADIOGRAPHIC EXPOSURE.

39. BOOSTER - In all valve models of the control there is a valve tube filament booster. This is a special device which automatically boosts the valve tube

filament temperature sufficiently to pass the milliamperage, which is flowing through the x-ray and valve tubes at that instant. When the control is in a "stand by" position with the main switch turned on, but the exposure off, the valve tubes are burning at a normal temperature. When the exposure is turned on, the valve tube temperature is automatically boosted immediately, so that it will pass the desired milliamperage without damaging the valve tube. Immediately after the exposure is over, it automatically returns to its normal operating temperature. This can be easily checked by observing the valve tube meter during an exposure of over 100 M.A. It should visibly increase during exposure. The valves will visibly brighten if observed through an open valve tube cover plate, and likewise a voltmeter installed at terminals 7 and 8 on the control will show an increase. One should check all three ways since the control meter may be affected by the flux from the autotransformer and not show an increase under exposure.

40. VALVE TUBE SETTINGS - On the main distribution panel or terminal board in the control, there is a valve tube filament primary ammeter. This has been calibrated at the factory with the valve tubes in the transformer.

41. It is very important that the limits specified on the valve tube primary filament ammeter must be held and should be checked carefully when the machine is installed. If the valve tube filaments are burned at too high a current, they will burn out prematurely, because of the excessive filament temperature. If the filaments are burned too low, they will not pass the desired milliamperage readily, and may become gassy or may even puncture.

42. The valve tube settings are calibrated in the following manner. A socket which has been arranged for a side parallel circuit is screwed on the bottom of a valve tube. This is then screwed into the valve tube socket in the high-tension transformer. An 0-15 AC voltmeter is connected in the side of the special socket and reads of course the secondary voltage at the valve tube filament. The valve tube filament primary voltage is varied by adjusting the major and minor valve tube filament adjusting straps. The valve tube secondary filament voltage should be varied between 9.5 and 10.5 volts and a curve plotted between this secondary filament voltage and the reading of the primary ammeter in the control. The valve tube primary ammeter should then be specified between certain limits, namely, on the fluoroscopic setting from 9.75 to 10.0 secondary volts and on the radiographic setting 10.0 to 10.4 volts.

43. OPERATION OF UNIT - The valve tubes are now installed by removing the four cover plates and screwing the valve tubes into the sockets which are directly under the cover plates and at the bottom of the transformer. Before installing the valve tubes wipe off the glass surface of the tubes with a clean, dry cloth. Be sure that the hands are free from perspiration when handling the tubes.

44. In order to safely try the unit, it is necessary to remove lead from stud 11 on the control panel so that no accidental exposure will be made on the transformer.

45. After having checked that the line voltage and frequency correspond to that stamped on the nameplate of the control and transformer, and having set the line adjuster to correspond with the line voltage as explained in paragraph 49, then the unit may be turned on. The major and minor voltage selectors as well as the filament control should be turned as low as possible.

46. With the main switch "on" and the focus switch on "small focus", see that the valve tube meter reads within the specified limits for "low M.A.". The limits are marked on the valve tube meter. If this meter does not read within the limits, then

it is necessary to adjust the strap on the three ohm valve tube limiting resistor. This resistor has two adjustable straps. However, they are tagged "small focus" and "large focus" so the correct one to adjust (in this case the one tagged "small focus") can be readily identified.

47. Now set the focus switch to "large focus" and check that the valve tube meter reads within the limits specified for "High M.A.". If it does not, then adjust the "large focus" strap on the three ohm valve tube resistor until it does.

48. If the readings of the valve tube meter when the control is first turned on are much lower than the specified limits, then it is possible that one of the valve tubes is not lit. This can be readily checked by observing the valve tube through the cover plate holes. The valve tubes should be screwed in firmly but not so tightly as to twist off the screw cap on the tube base.

49. With the major and minor KV selectors turned back to zero position the KV meter will read just below 30 KV and with them advanced to the highest position the KV meter will read about the maximum KV rating of the unit--110 KV. If it does not, then the line adjuster is not set on the tap corresponding to the line voltage. If it was previously checked to be correct, then it is possible the voltmeter used may be off calibration.

50. Since there is no x-ray tube connected if the voltmeter switch is depressed to the filament side, the meter will indicate about full scale deflection or a little beyond, nor will the filament control have any effect on the reading. This condition is normal.

51. The exposure circuits should now be checked. Install a voltmeter at studs 11 and 12 on the control panel and then turn on the main switch. The meter should not read.

52. Set the timer for, say, two seconds and depress the timer push button. The voltmeter should read then for two seconds.

53. Cock the bucky and set the dial for two seconds. Then depress the bucky release switch. The voltmeter should read again for two seconds.

54. If the bucky is wired so as to be timed by the timer as explained under paragraph 25, then the bucky will be released and exposure will be obtained when the timer push button is depressed.

55. In order to obtain an exposure with the footswitch, the exposure switch must be "On" and the focus switch on "Small Focus". Check this and also check that no exposure is obtained with exposure switch "Off" and/or focus switch on "Large Focus".

56. Any auxiliary 110-volt devices, such as magnetic trips, etc. can take their source of supply from terminals #4 and #9 on the control terminal panel. This circuit is fused by the 15 ampere fuse on the terminal panel. This fuse is also in the valve tube and x-ray filament supply.

57. Now connect high-tension primary lead to stud #11 on transformer. Assuming that you have the x-ray tube mounted on the tube stand or in the table according to the instructions with that unit, and that the cables are plugged into the tube head (with due regard to polarity), then install the transformer ends of the cables into the cable jackets in the transformer. The cathode cable has three concentric springs and the anode cable only two. The transformer receptacles are stamped "A"

and "C" for anode and cathode. Also the cathode receptacle can be seen to have three concentric rings at the bottom while the anode receptacle has only a flat disk. The cathode cable coming from the x-ray tube filament must be plugged into the cathode jacket in the transformer.

58. The transformer, Figure 3, normally is equipped with only one pair of receptacles. However, it is possible to obtain this transformer with two pairs of receptacles for the operation of two tubes. The changeover from one tube to the other is made by a high-tension switch inside the transformer. This switch may be operated manually by a shaft and knob which protrude through the terminal cover casting, or a motor drive may be adapted as in paragraph 12. The actual operation of the motor is made by a switch mounted in a housing which bolts on the side of the control.

59. In a two-way transformer the receptacles are paired along the long side of the transformer. They are also numbered 1 and 2, the two #1 jackets being one set of jackets for one tube.

60. With the tube now connected and filament control turned down, turn on control and observe tube through window to see if it lights. With the control on "Large Focus" the large focus of the tube should light in the case of a double focus tube, and likewise on the "Small Focus" setting the small focus should light.

61. CALIBRATION - The calibration of the unit is very carefully checked at the factory, and there should be no need to change this calibration excepting under very different line conditions. Because supply lines vary in capacity from one location to another, some adjustment is provided to maintain the accuracy of the kilovoltmeter. This adjustment is explained in paragraph 18.

62. In order to calibrate the unit, it is necessary to have a pair of calibrating adapters, Catalog #11175-C and D. These adapters plug into a PX tube and the cables which normally plug into the tube now plug into these adapters. In the center of these adapters two studs protrude and to these studs a sphere gap can be installed. There is a jumper between these studs on the adapters and if the jumper is removed on the anode adapter a high-tension MA meter can be installed (thus the accuracy of the control meter can be checked). Likewise, if the jumper on the cathode adapter is removed, a high-tension filament ammeter can be installed (this puts the meter in the common filament connection of the x-ray tube and thus the current drawn by each focus can be obtained). These adapters can be obtained from the factory, and it is quite probable that each service department has a set.

63. If other than FX tubes are used, calibrating adapters can be obtained from the tube manufacturer, or a pair of stub cables, Catalog #18124, can be obtained. These adapters plug into the transformer rather than the tube head and are not quite as handy to use. However, they can be used with all x-ray tubes.

64. In operating the unit the rating chart accompanying the x-ray tube should be consulted so that the maximum exposure time and milliamperage for the focal spots used are determined. Note that these ratings are based on a cold anode at room temperature, and as the tube is used the maximum values cannot be used unless the tube is allowed to cool to room temperature.

65. In general the tubes supplied with this unit do not permit a long enough exposure time at high milliamperages for the exposure to be held on long enough so that the sphere gap may be drawn in and a kilovoltage reading obtained. If the sphere gap is held at a stationary value, this value being decreased until an arc

across the gap is obtained (the gap being held fixed while the exposure is tried), then the values of kilovoltage obtained will be higher than the useful kilovoltage since this will record any surge voltages obtained at the instant of the turning on of the exposure.

66. It is necessary then to use an impulse timer and contactor (this being accurately phased in) in conjunction with a ballistic meter to calibrate at high milliamperages unless a tube with high enough ratings is substituted for calibration purposes.

67. A high-tension ballistic meter can be installed by means of the calibrating adapters as in paragraph 62, or if a low-tension AC type (usually a DC movement with a copper oxide rectifier) is used, this can be connected at the control by putting it in series with lead #5 from the transformer to #5 on the control. If a ballistic meter of this type is to be connected permanently, an "On" and "Off" toggle switch can be installed across the ballistic meter terminals so as to put it in or out of the circuit. A ballistic meter of this style with housing for wall mounting and incorporating "On" and "Off" switch and with connecting cable can be obtained from the factory.

68. At the back of this manual a filament settings chart is included. This should be filled in for the milliamperages which are desired to be used, and over the range of kilovoltage also used (the latter in 10 KV steps should be sufficient). The readings to be plotted are those of the pre-reading filament meter. These are obtained by depressing the voltmeter switch to filament and reading the upper red scale of the kilovoltmeter. These readings for the same milliamperage will decrease slightly with increasing kilovoltage. This is normal and is due to space charge effects within the x-ray tube.

69. CONTACTOR - The contactor is mounted at the rear of the terminal board and can be reached from the front of the control. The spacing of the contacts is very important especially with regard to surge suppression. A diagram is included to show the correct spacings. As the contacts wear from use it is necessary to install new contacts. These can be obtained from the factory as Catalog #9025. A pair of room light contacts go to studs #28 and #29 on the terminal panel. These studs are not energized, so that a room light energized from the lighting circuit may be connected; or if the supply is to be taken from the control, the room light can be put in series with the contacts and studs #4 and #9 as the source.

70. TIMERS - The control is normally equipped with a 929 type timer. The only adjustment provided is at the 1/10 second setting. If the exposure time at this range is doubted, spinning top films should be taken. The number of dots obtained should be from 11 to 13 to be correct, that is, one film may give 11 and another 13. If higher or lower values are obtained, turn the timer dial to 1/10 second, remove the screw in the knob by which the time is set. This will then allow the knob to be removed. Underneath this knob will be found a screw at the back of the dial. The latter is labelled with the direction the screw must be turned so as to increase or decrease the exposure time.

71. A 914 timer is sometimes substituted for the 929 timer. This timer mounts on top of the control by means of a pair of mounting brackets. The control wiring diagram shows the connections for hooking up this timer, and on the underside of the timer cover are instructions regarding adjustments.

72. Other timers such as fluoroscopic and therapy timers can be connected by connecting the motor leads to studs 4 and 9 and the contacts to studs 2 and 9. Some of

these timers have only three leads since one side of the contacts and one side of the motor are made common at the timer. This lead then goes to stud #9. If the motor and contact leads are separated, then the contacts can go to studs 24 and 25. Then an exposure can be obtained only on "Small Focus" and only with the exposure switch "On" and the milliamperage will also be limited to a low value.

73. POSSIBLE OPERATING DIFFICULTIES - If the voltmeter does not indicate, make sure:

1. That the line cable is properly connected to the receptacle of the supply line.
2. That there is voltage at this source of supply.
3. That there are no blown fuses.
4. That there is no break in the conductors within the line cable. This is most apt to occur at or near the point of connection of the cables to the transformer or control.
5. That a voltage selector switch is not set on a dead button.
6. That there are no loose connections at the distribution panel within the control.
7. That the main switch is turned on.
8. That there is no open in the resistor associated with the voltmeter.

74. If the milliammeter does not indicate:

1. Make sure that the x-ray tube filament lights up.
2. Examine the connections of the control cable at the transformer. Be sure that it is properly connected and that no wires are broken off. This can usually be determined by slightly flexing the cable near the end with the idea that if a wire is broken, its ends may be brought in contact by flexation, lighting the filament temporarily.
3. Make sure that the timer or footswitch is properly connected and that good contact is established at this point. Further, that there is no failure in the timer or footswitch which usually can be determined by substituting one for the other.
4. That the circuit breaker knob is pushed all the way down.

75. Milliammeter indicates, but fluctuates:

1. Slight fluctuation may be expected because of line voltage changes. This can usually be traced to line voltage by watching the voltmeter and the milliammeter at the same time. If both show a change but if the change is greater at the milliammeter than at the voltmeter, it generally indicates fluctuation in line voltage. It may also indicate loose connections within the unit or in the supply line, but in most cases at the connecting lugs of the line cord.
2. If the milliammeter fluctuates severely and the voltmeter is quite steady, it may indicate a loose connection in the filament circuit of the x-ray tube possibly at the point of contact between the tube holder and its cable. The x-ray tube will have to be removed to correct this. It is not likely to occur and all other conditions should be checked first.

76. If the x-ray tube does not light:

1. Check for voltage at x-ray filament terminals on control terminal board. If there is no voltage here, check fuse, check stabilizer and check for

broken wires or loose connections in control wiring.

2. If voltage is satisfactory at terminals on control board, then check voltage at transformer primary terminals of the filament circuit. This will determine if the fault is in the connecting cable. If the voltage is at these terminals (50 to 100 volts) then check for possible poor connection or broken connections in the shockproof high-tension cables.
3. If the voltage can be checked at the tube end of the shockproof cables (approximately 6 to 15 volts) and the tube still does not light and the cable terminal is clean and makes good contact with the x-ray tube terminals, then the tube is probably burned out and should be returned to the factory for replacement or repair.

77. If circuit breaker kicks out:

1. If circuit breaker kicks out at or near maximum loads, reduce the milliamperage by 50% and try it. If it does not kick out at reduced milliamperage at the same kilovoltage, the circuit breaker is probably set too low and it will be necessary to raise the milliamperage tripping point. This is done by lowering the adjusting screw a half turn.
2. If the circuit breaker trips even at reduced milliamperages, it may be caused by a sparkover or a failure of insulations. This is accompanied by an excessive voltage drop as indicated on the kilovoltmeter. Usually this is accompanied by noise and bubbles in the transformer. By removing the valve tube covers, visual inspection can be made.
3. If the x-ray tube is gassy or one or more of the shockproof cables is punctured, the circuit breaker will kick out. In checking trouble of this type, first remove the x-ray tube, and then check the operations. Then remove the shockproof cables one at a time and check again. If the circuit breaker still kicks out and the kilovoltmeter still drops excessively, then the trouble may be in the transformer or with the valve tubes.
4. Remove the valve tubes and try it again. To check the valves put in two valves at a time (in opposite corners of the transformer) and operate it as a half wave, two valve machine. Changing one valve at a time will show up any defective valve tube. If a valve is only slightly gassy, it may be erratic in its operation. The best way to determine if there is a gassy valve is to take a no load sphere gap calibration. It should be a straight line. If it curves upward from a straight line at the higher values, that is, if the sphere gap value for the same primary voltage is higher than the straight line value, it indicates one or more gassy valves.

100 MA CONTROL (P)

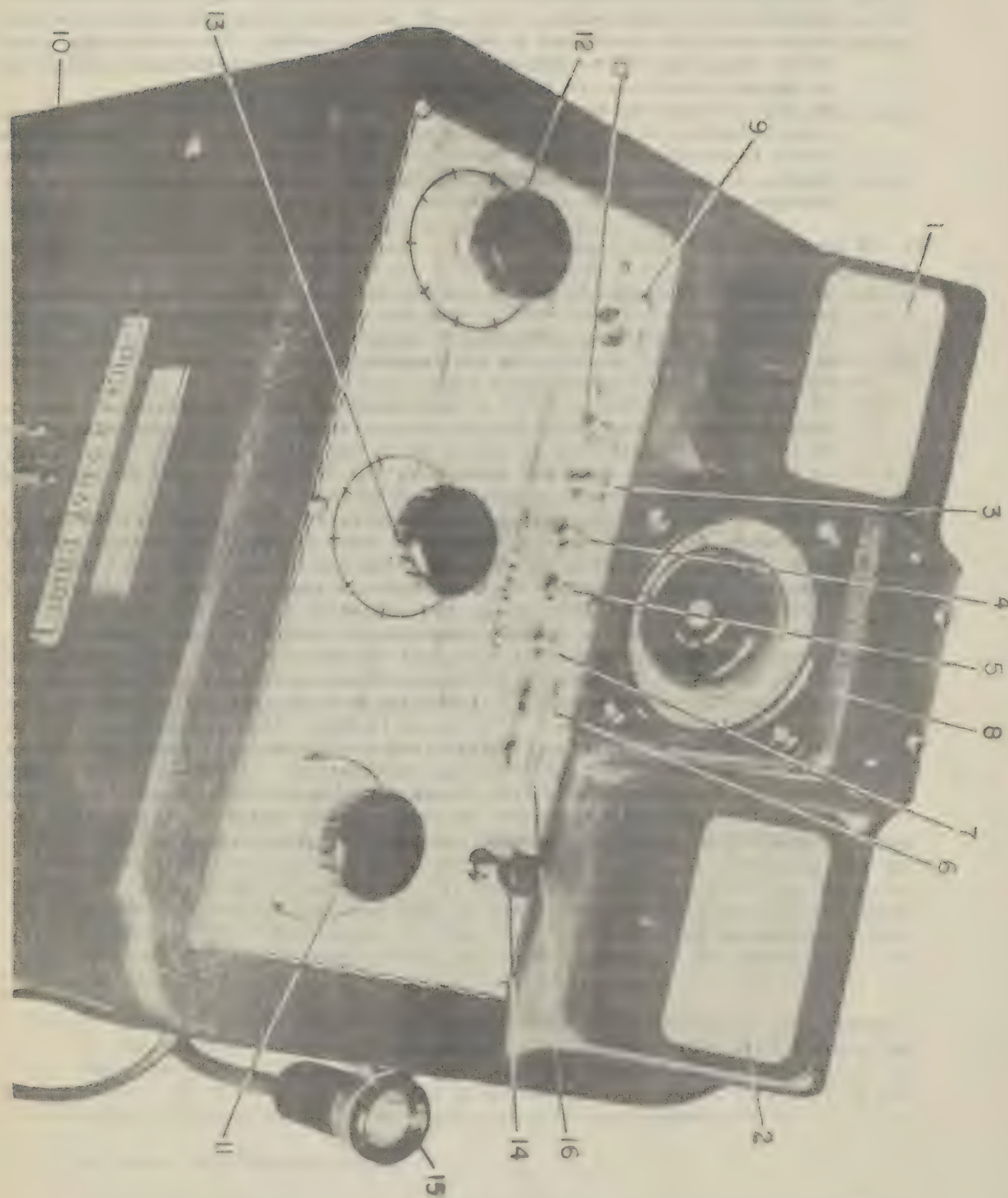


FIG. 1

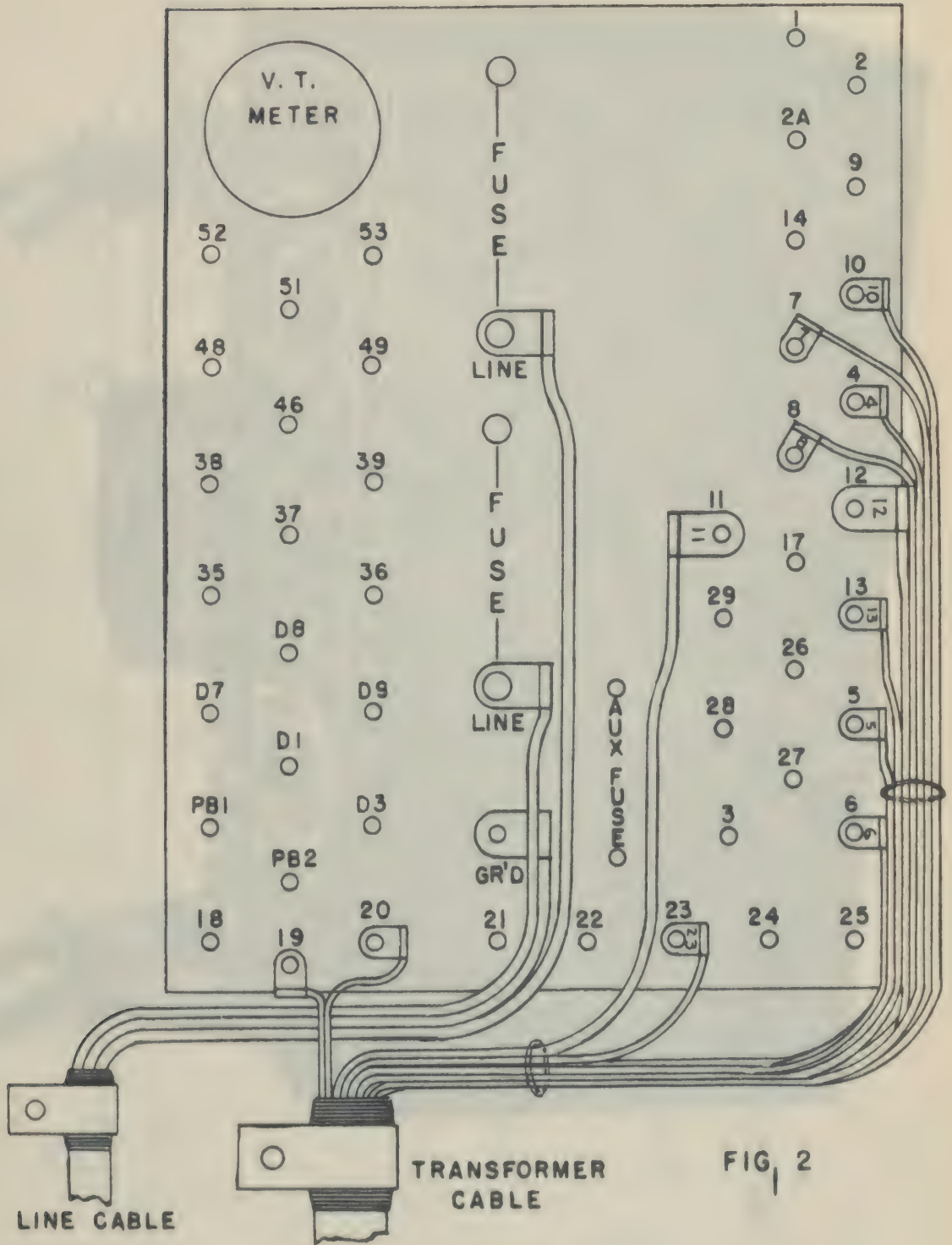


FIG. 2

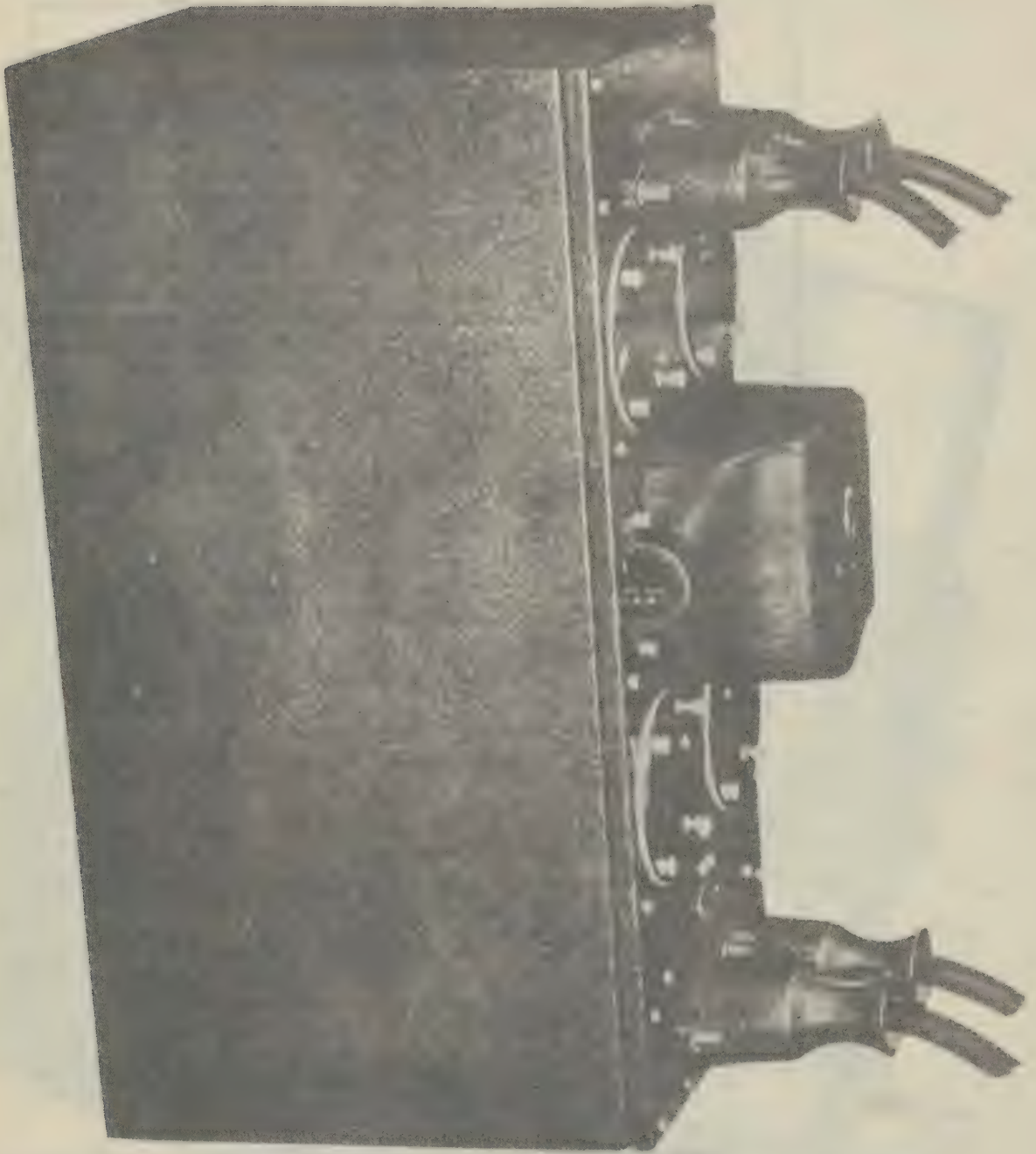
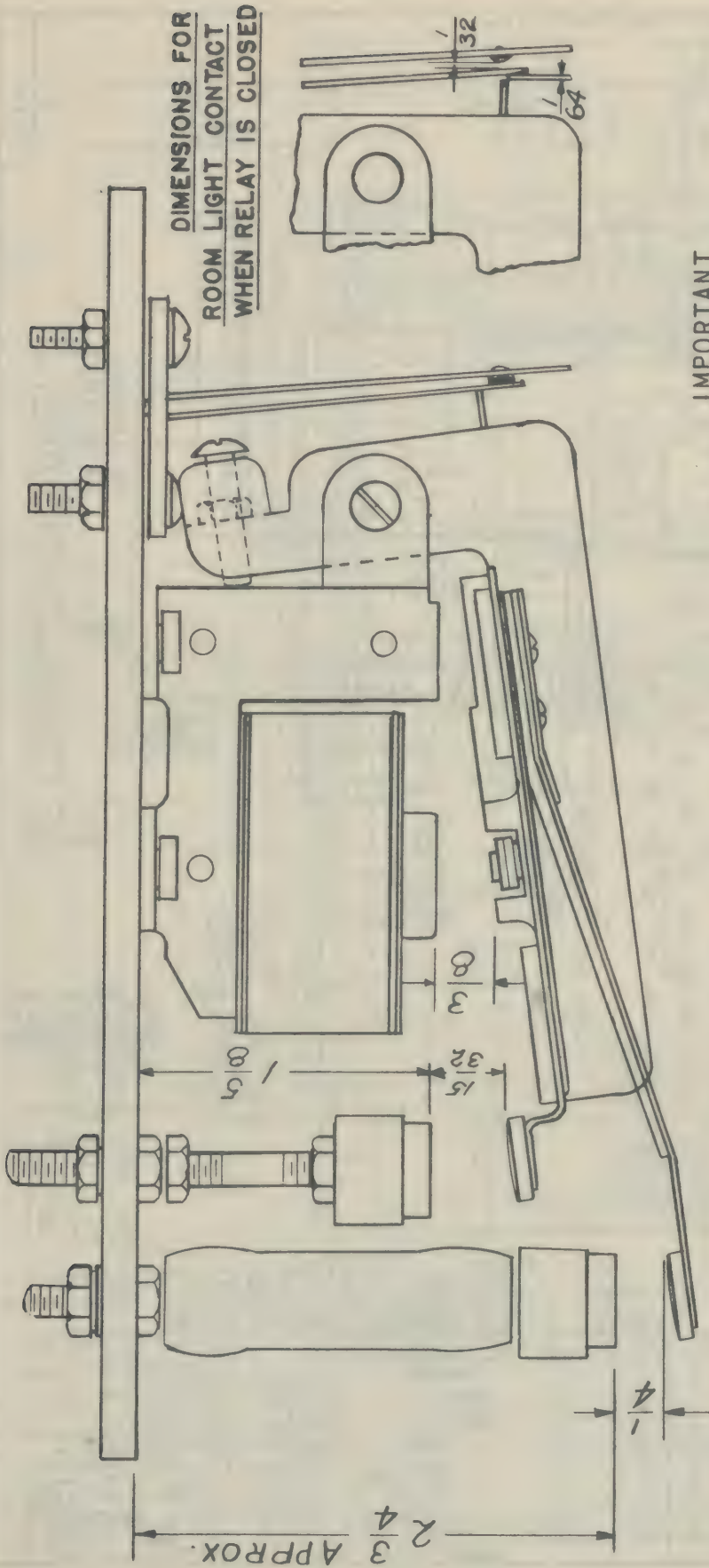


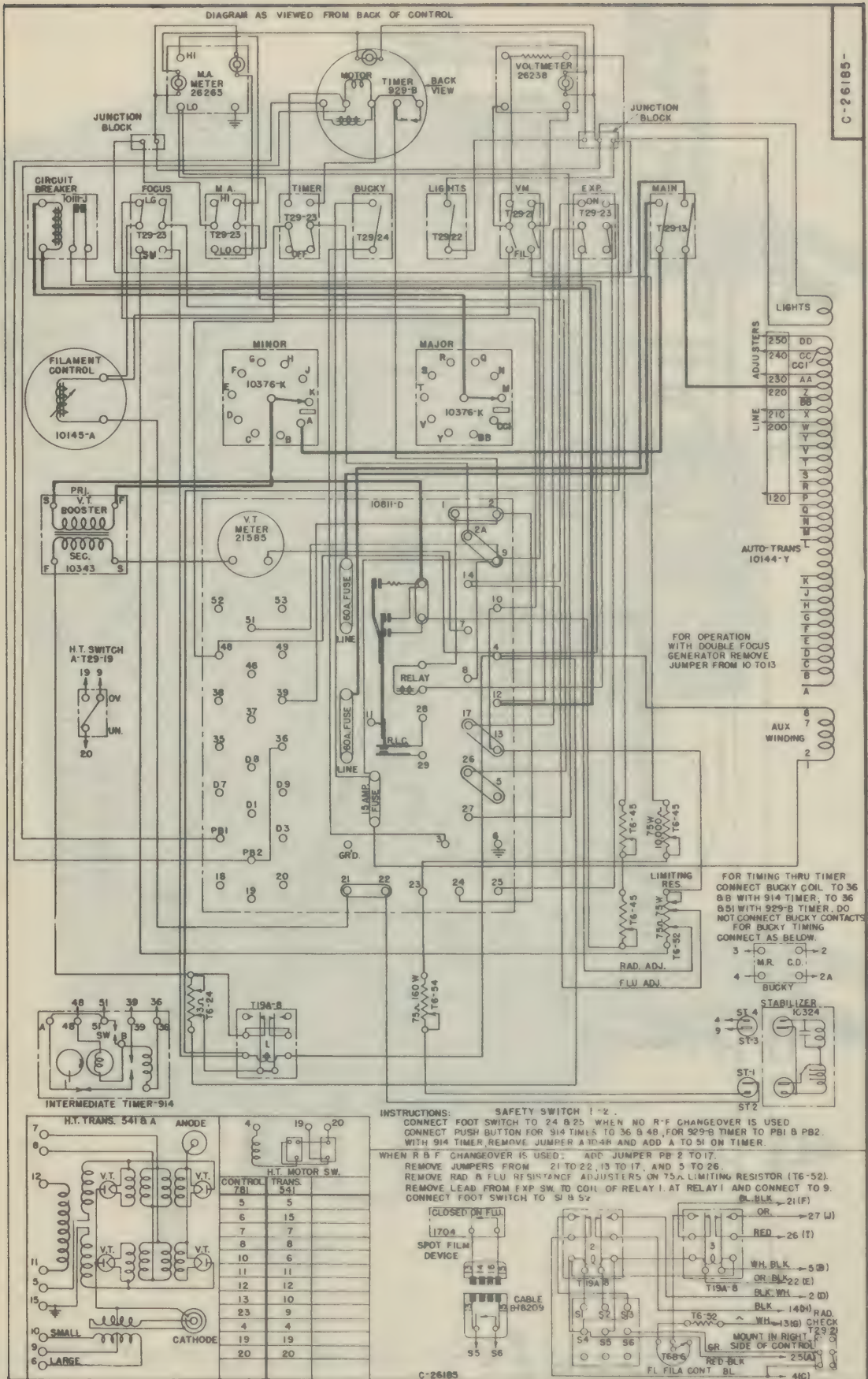
FIGURE 3



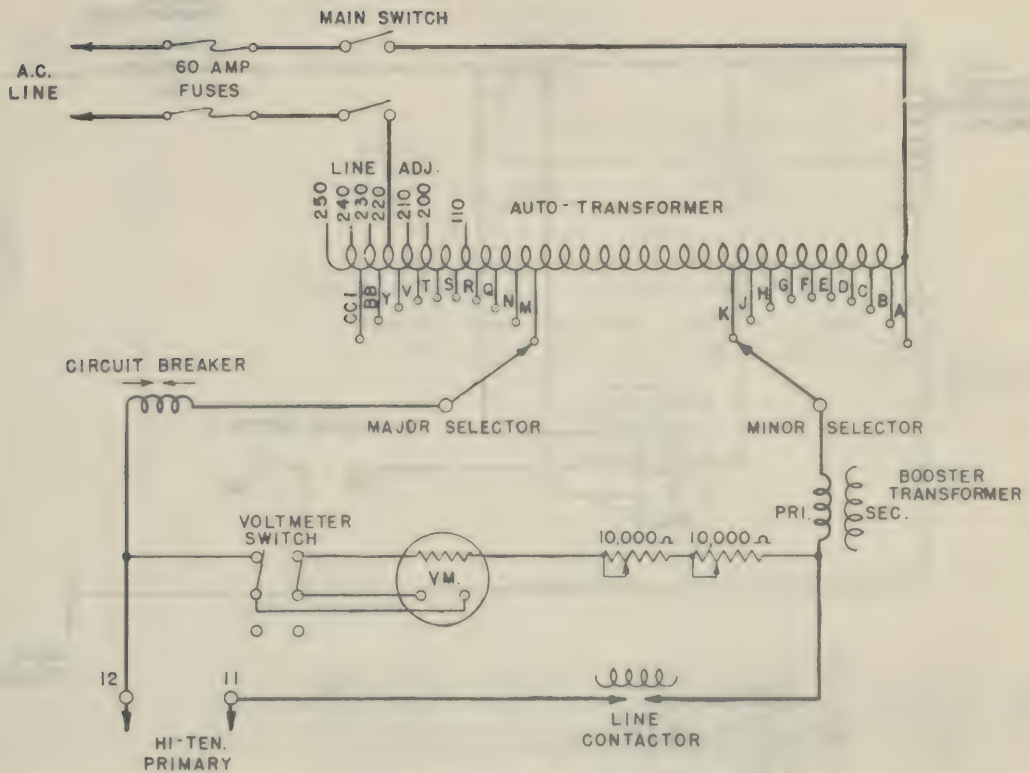
IMPORTANT
WHEN INSTALLING NEW CONTACTS
THESE DIMENSIONS MUST BE HELD

CLEARANCE WHEN ARMATURE
IS CLOSED BOTH SIDES EQUAL

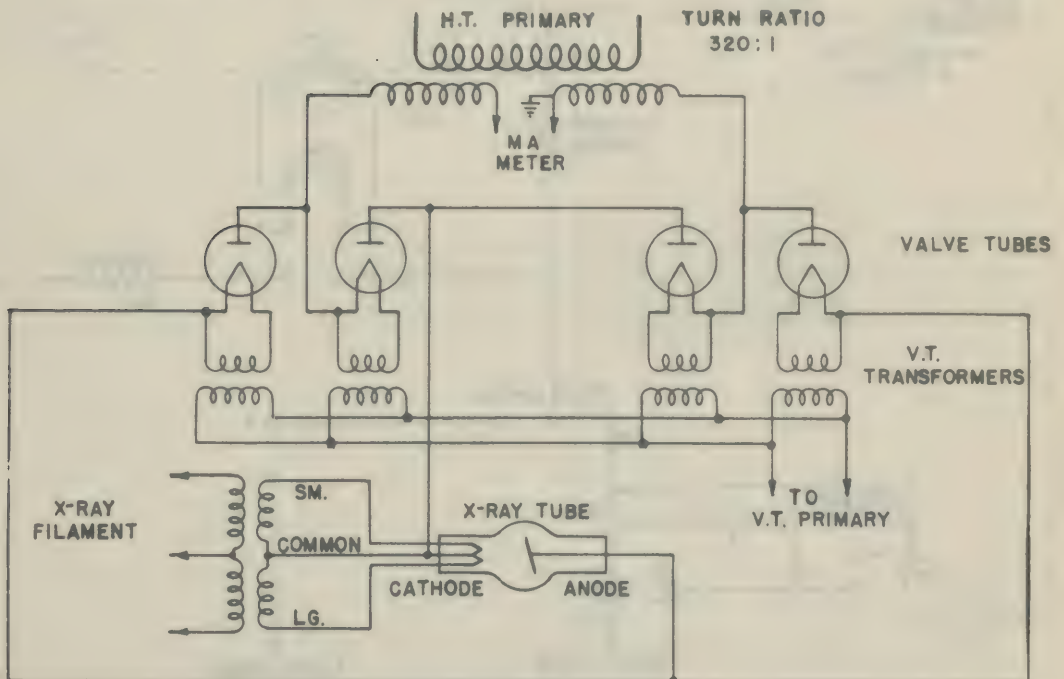
100 MA CONTROL (P)



100 MA CONTROL (P)

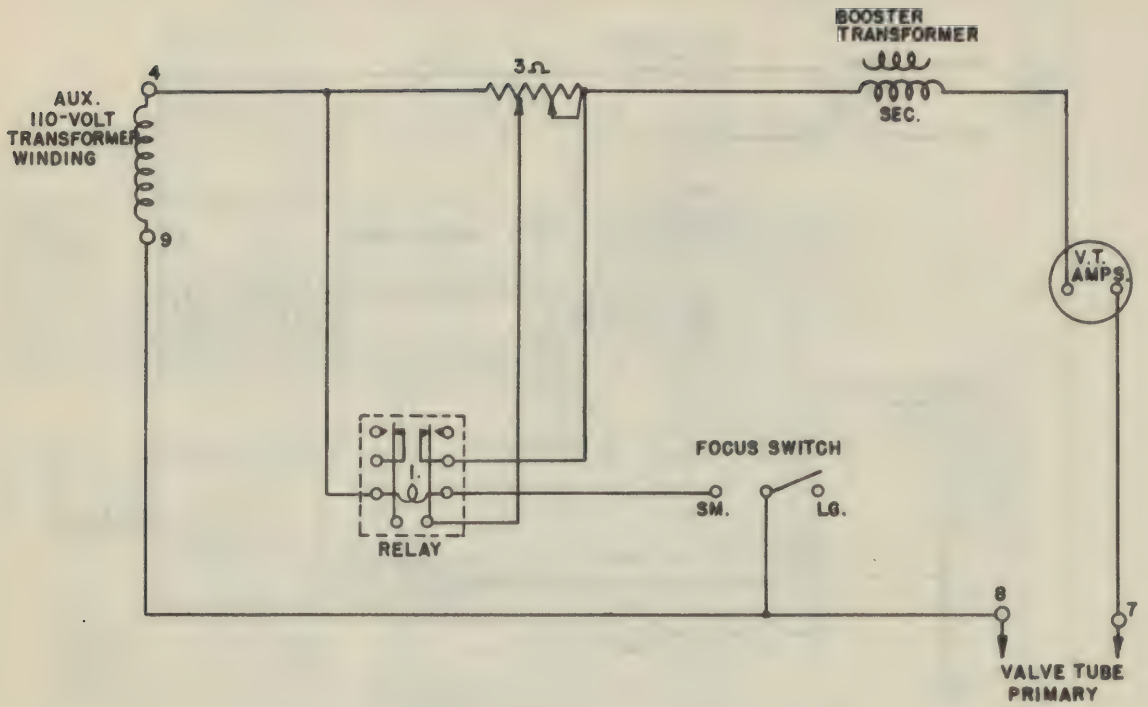


HIGH TENSION PRIMARY CIRCUIT

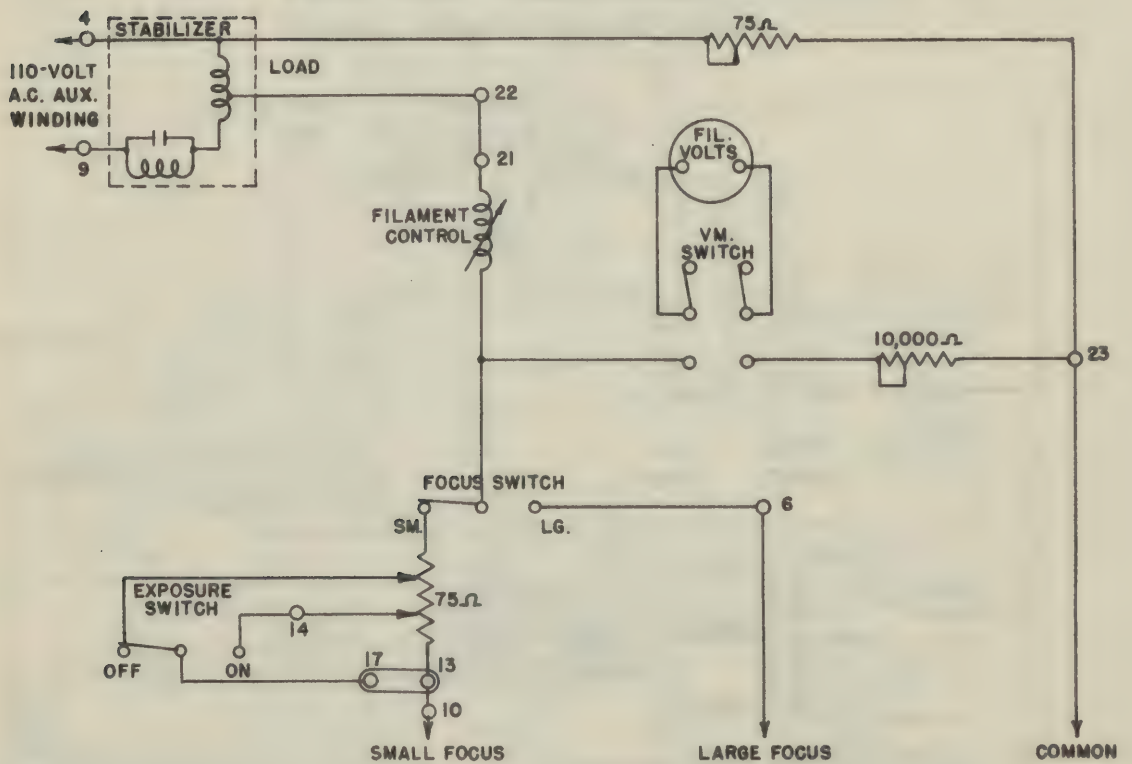


HIGH TENSION CIRCUIT
541 TRANSFORMER

100 MA CONTROL (P)

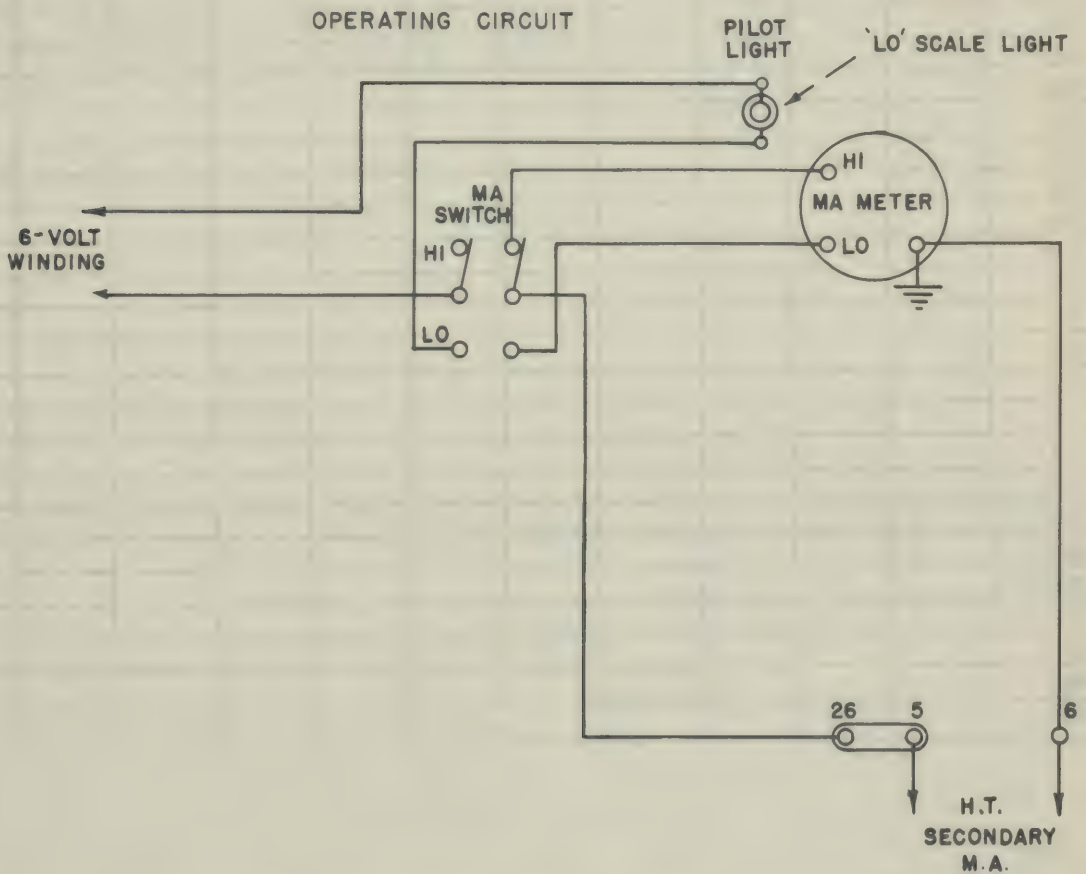
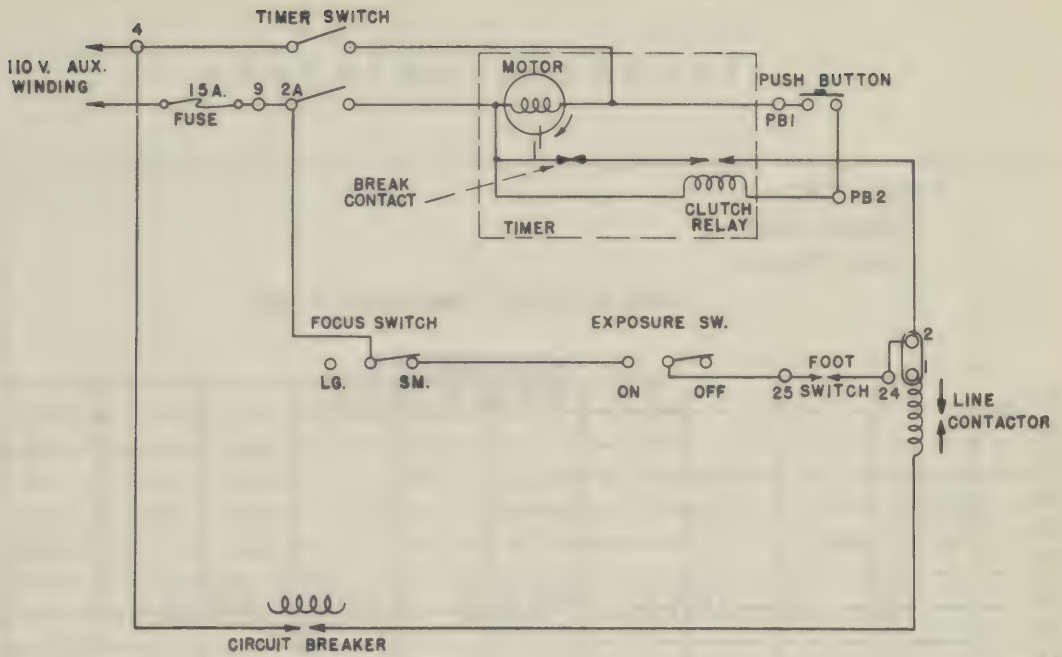


VALVE TUBE PRIMARY CIRCUIT



X-RAY TUBE FILAMENT CIRCUIT

100 MA CONTROL (P)



MILLIAMMETER CIRCUIT

FILAMENT SETTINGS

K. V. P.	X-RAY TUBE Under Table Over Table LINE VOLTAGE COMPENSATOR AT MILLIAMPERES										K. V. P.
30											30
32											32
34											34
36											36
38											38
40											40
42											42
44											44
46											46
48											48
50											50
52											52
54											54
56											56
58											58
60											60
62											62
64											64
66											66
68											68
70											70
72											72
74											74
76											76
78											78
80											80
82											82
84											84
86											86
88											88
90											90

Date-

Calibrated by-

SECTION XL

KELEKET TYPE 100 - A - 2

SECTION 21

SECRET 100-4-2

KELEKET TYPE 100-A-2

INSTRUCTIONS FOR INSTALLING AND OPERATING KELEKET TYPE 100-A-2 RADIOGRAPHIC AND FLUOROSCOPIC CONTROL WITH EITHER 100-A-2 OR 100-B-1 TRANSFORMER UNIT

UNPACKING - Care should be taken in unpacking so as not to damage any parts. Check and examine all packing cases so as not to overlook any small parts in packing material. Should there be any parts missing, notify the Medical Supply Officer at once. Special care should be given in respect to handling X-ray tubes and high tension cables when included with the shipment.

ELECTRICAL CONNECTION - The Main Service line to accommodate the 100-A-2, 100-B-1 Energizing Units should have the following capacity.

TECHNIQUE	LINE VOLTAGE	LINE FUSES	MINIMUM SIZE OF SUPPLY LINES		
100 M.A.	220 V.A.C.	75	200 ft.	100 ft.	50 ft.
80 K.V.P.			#0	#1	#2

NO. 6 B.S.G. - Stranded wire should be employed for ground wire. The ground wire should be carried along with the two feeders of proper size as indicated. A substantial water pipe ground is the only acceptable connection. Suggest a Pole Transformer of 15 K.V.A. capacity free from other loads.

It must be understood that in X-ray procedure, we are mainly interested in keeping the potential drop across the X-ray tube under maximum instantaneous loading at the lowest minimum.

Another point to consider is that Self Rectified Half Wave equipment requires power feeders represented by twice the carrying capacity as employed by four valve or full wave rectified equipment.

The 100-A-2 or 100-B-1 energizing units and remote control are designed to operate in connection with regular shockproof single or double focus, regular or right angle tube.

The **CONTROL CABLE** is generally shipped attached to the Energizing Unit. The standard length cable is fifteen feet long which allows proper positioning of Control Unit which is the mobile type.

Refer to sketch that shows complete wiring diagram of Control Circuits. The control cable includes the following labeled wires: "FZ", "Z" and "F" are primary tube filament transformer wires where "FZ" is the Common and "FZ"-"Z" furnish primary actuating Small Focus and "FZ" - "F" furnish current for Large Focus. X and Y connect to X-ray Energizing Transformer primary. "M" represents mid secondary Milliampere meter lead. "G" indicates ground connection between Control and Energizing Transformer. This lead also carries mid secondary ground connection for Milliampere meter. Control panel connections A and A-1 are employed to energize solenoid of oil immersed High-Tension Switch Magnet whenever the 100-B-1 transformer unit is ordered to operate two double focus X-ray tubes. In the 100-B-1 transformer unit there is no provision for directly connecting inlet cable to the unit which was possible with 100-A-2.

Pilot lights "B" and "A" on control panel light up depending upon the direction the high-tension switch current has been thrown by action of Tube Selector Toggle. Tube "B" may be considered below table and Tube "A" the one above table. When 100-B-1 Transformer is not employed, the extra wires on control cable (A & A-1) should be thoroughly taped. (Thorough water pipe ground should be made from this connection Control panel).

KELEKET TYPE 100-A-2

BUCKY CONNECTION CABLE - This is a flexible three wire cable extension with plug end attached to the Bucky Diaphragm. The three lugs are marked "CX", "LX", and "B". The code is as follows: White wire connects to "CX", Black to "LX", Red to "B".

The FOOTSWITCH cable should be connected to connection post marked Foot Switch.

FILAMENT STABILIZER - No provision has been made on 100-A-2 Control connection panel to directly interpose a filament circuit stabilizer. If a 110 to 110 V. filament stabilizer is required, then a small bakelite connection block must be fastened to lower edge of present control panel. This connection block should be marked centrally in large letters "STAB" indicating its purpose and should include four connections. Between the top two, mark "IN" and the bottom two, mark "OUT" indicating stabilizer "IN" for inlet and "OUT" for outlet. Connect one of the "IN" studs to panel stud marked TIMER and the other to fused stud marked "LX". Remove control cable lug marked "FZ" and connect to one of "OUT" studs. Disconnect the Filament Compensator Secondary from AUTO-120 and run wire from Secondary down to other "OUT" stud.

After the introduction of the filament Stabilizer, the Filament Compensator Transformer Secondary Adjuster Tap may have to be changed to allow proper bucking effect and to keep the Milliamperage constant throughout the full auto voltage regulation from 29 KV. to 90 KV. Test stabilizing effect of Compensator transformer with 30 MA load only as this test will also guarantee proper operation on 60, 75 and 100 MA.

A flexible INLET cable (not furnished) should be connected from properly installed safety type switch and fuse panel to points on Control Panel marked MAIN. (While machine is being connected and before equipment is to be tested we suggest the removal of the MAIN 60 amp. Control Panel fuses.)

AUTO TRANSFORMER ADJUSTMENT - This adjustment should match the line voltage measured across contacts marked "MAIN". The sketch shows two Auto Adjuster Leads, one marked Auto-O is attached directly at the Main Control Switch, the other marked Auto-240 connects directly to the outside 60 Amp. main fuse. These connections are proper for 240 Volt line voltage. Connection of Adjusters to "0" and 220 accommodates for 220 V. line. Connection of Adjusters to "10" and 240 will accommodate for 230 Volt Line while "10" and "220" Taps will be proper for 210 Volt line.

FILAMENT COMPENSATOR TRANSFORMER CIRCUIT - This transformer unit is shown in the sketch to the right and below Minor Auto Regulator. This unit is to hold the M.A. constant for any tube current over a voltage range from 29 K.V.P. to 100 K.V.P.

The primary is connected across the wires extending from Major and Minor Auto Transformer Levers or central connections. The secondary which is adjustable for use with all types of X-ray tubes is placed in Series with X-ray Tube filament regulating circuit. As the Auto Transformer setting is increased, the voltage in the X-ray Tube filament circuit is decreased just enough to allow the cathode stream and therefore the Milliamperes across the tube to remain constant. Tube saturation takes place around 80 K.V.P. and at this point the magnetic flux of Compensator Transformer has increased to a maximum and corrective action stops. This effect will be noticed on Prereading Ampere Meter and for this reason all prereading values must be taken at a Constant K.V.P. We have selected a point of 50 K.V.P. where Prereading Ampere Values may be accurately determined without overloading the focal spot.

KELEKET TYPE 100-A-2

To check the action of Compensator Transformer simply employ 30 MA load across the tube because if filament current is proper to substantiate 30 MA reading between 29 K.V. and 100 K.V. then 60 and 100 MA load will also be constant. As the number of turns in the secondary are decreased the bucking effect decreases. A tap is selected which will most nearly keep the Milliampere reading constant between 29 K.V.P. and 90 K.V.P. employing the 30 MA load.

DOUBLE FOCUS ADJUSTMENT - The Double Focus Toggle Switch indicated on the sketch as tube FOCUS changes the Filament current from the *small* 2.2 mm projected focal spot to the *large* 3.8 mm focus or preferably 4.2 mm in series with primary when toggle switch is thrown to *Small Focus*. This should be adjusted so that when Filament Regulator (indicated in sketch center right) is proper to allow 100 MA at 50 K.V.P. on *Large Focus* and switch is thrown to *Small Focus*: the reading will be 30 MA. This 100 ohm series resistor is a definite safety medium to normally prevent the overloading of the *Small Focus Spot*.

FOCUS PILOTS - Whenever the Tube Focus toggle switch is thrown to upper position then pilot light marked L.F. (Large Focus) will indicate, and when moved to lower position will light pilot marked S.F. (Small Focus).

TUBE SELECTOR TOGGLE - When control unit is employed with 100-A-2 transformer which does not include magnetic high-tension switch; the Tube Selector Toggle simply energizes "B" Pilot or "A" Pilot therefore, toggle may be left in either position on the 100-A-2 Control.

TIMER AND FOOT SWITCH TOGGLE - On all 100-A-2 controls shipped with wiring diagram #C-70525-2, the circuit of the selective Timer and Foot Switch Toggle will be arranged to shut off all pilot lights when thrown to Ft. Switch for fluoroscopy.

FILAMENT REGULATOR - This regulator is shown as Fil. Reg. and corresponds to MILLIAMPERES control on control panel.

TECHNIQUE REGULATOR CIRCUIT - This control marked TECHNIQUE is located to the upper right of Switch panel. The purpose of the regulator is to correct the *Prereading Kilovolt Meter* readings depending upon the Milliampere loading of the X-ray tube. This potentiometer is interconnected with auto transformer levers and special independent auto transformer winding shown as T-O and T-50. Generally speaking the Technique Dial at Regulator and the variable 3500 ohm resistor in series with T-50 inside of control are adjusted and will not have to be moved unless machine is placed on a poor overloaded power line. Do not disturb the 3500 ohm resistor.

The Technique Regulator has a scale indicating Milliampere load setting for every 10 MA and must be set opposite the X-ray tube current in MA to be employed otherwise Kilo-Volt Meter will not properly preread Kilo-Voltage Peak. For simple adjustment, the Regulator Knob may be removed by unscrewing recessed setscrew. The Scale is held by two setscrews and may be moved clockwise or counterclockwise so that *Prereading Kilo-Volt Meter* is correct for Tube current loading.

The proper setting of this Regulator Dial will be described later under MACHINE CALIBRATION AND TESTING. The Potentiometer may be moved from beneath panel by loosening check nut which accomplishes similar correction.

TIMER - The synchronous exposure timer generally furnished in #3626 Keleket "LK" Type. When ordered with 100-A-2 Control Unit, it will be installed and mounted on shelf behind Meters.

This synchronous motor timer produces exposures from 1/10 sec. to 14 sec. The first second is divided into 1/10 second divisions. The rest of the Timer Dial is divided into 1/4 seconds although a setting for every 1/8 seconds may be obtained by setting between divisions.

Connections are indicated on rear of Timer case. Facing rear of timer then first set of wires connect to *Timer Push Switch* having white button. Second set of wires "INPUT" are to be connected to the 115 Volt .25 amp supply which is "B" and "LX" on Control Connection Panel. Third set of wires marked "OUTPUT" to X-ray Relay connect to "B" and "CX" on Connection Panel. Bucky settings should be increased above desired exposure.

DESCRIPTION OF CONTROL PANEL

METERS - The three primary meters are mounted at the rear of control panel. From left to right will be found the *Milliampere Meter*, *Prereading X-Ray Tube Filament Ampere Meter*, and *Prereading Kilo-Volt Meter*.

TIMER - The "LK" Synchronous timer 1/10 second to 14 seconds is mounted on shelf behind the meters.

TECHNIQUE REGULATOR - This regulator is located just in front of Meters and to the right hand side of Control. The Dial is marked off in divisions of ten between 10 and 100. The motion of Technique Regulator Knob over the Dial corrects the prereading of the Kilo-Volt Meter for the different X-ray tube loads in Milliampere as indicated. The regulator must be set in accordance with Milliampere values indicated on dial. If 25 MA is to be employed across the X-ray Tube then knob should be set half way between the 20 and 30 positions. This Dial may be readily adjusted to compensate for poor line conditions.

MILLIAMPERES - This control is the Tube Filament Regulator, the motion of which will influence the reading of Milliampere Meters and also primary Prereading Ampere Meter. (This regulator should be always tested by operator at 50 K.V.P. or less in order to appreciate the sensitivity of Regulator action, thus not overheating the X-ray tube focus.)

AUTO TRANSFORMER - This voltage adjuster is a 64 step Regulator with eight *Major* and eight *Minor* steps. The adjuster is a combination Regulator employing Lever Handle for adjusting Major steps and Knob mounted centrally for Minor selection. (No cognizance is made of Auto Transformer Dial markings as regulators are turned until certain Prereading Kilo-Volt Meter indication is derived.)

MAIN - This is the Main Control Switch and selective between Fluoroscopy and Radiography.

RELAY - This is the standard adjustable Overload Relay. An arbitrary dial scale is employed where increased load adjustment is accomplished in clockwise motion. When reset knob is lifted either manually or electrically, the Main Magnet Relay Switch circuit is opened which stops all energy from flowing across X-ray Tube. When installation is being accomplished, this adjustable safety relay should be set at a point which will not allow Reset Knob to stay depressed at a Tube loading above 100 MA at 80 K.V.P. One tenth second timer exposures should be employed to determine this point (waiting three minutes between exposures so as to not harm the Large Focus.) Suppose that the proper overload setting has been determined and during future operation the Reset Knob releases electrically, then do not reset knob until source of trouble has been eliminated.

KELEKET TYPE 100-A-2

TUBE FOCUS - This is a toggle switch for changing the X-ray Tube filaments to control two tube focuses. Indication of switch position for the two tube filaments is shown on Control Panel. **LARGE** - This focus is a 3.8 mm. or 4.2 mm. projected size and is to be employed for all X-ray tube loading above 30 MA such as 60 MA. and 100 MA Radiographic procedure. **SMALL** - This focus is a 2.2 mm projected size and is employed for all X-ray tube loading up to and including 30 MA also Fluoroscopy. Providing instantaneous Gastro Intestinal work is to be accomplished from Fluoroscopic position with 60 MA then to simplify operation we would suggest fluoroscopy with the large focus. One side of this toggle switch controls Pilot lights, Large Focus and Small Focus indication.

TUBE SELECTOR - This toggle when employed in connection with 100-B-1 double tube transformer with high-tension switch, operates solenoid of H.T. switch also allows pilots "B"-Tube and "A"-Tube to indicate particular X-ray tube in use. (With 100-A-2 transformer, the pilots will light on throwing toggle but it will make no difference in the operation of equipment which way this switch is thrown.)

TIMER - FOOT SWITCH - This selector toggle allows either the LK synchronous timer or Foot Switch circuit to actuate at any one time.

CONTROL ADJUSTMENT - (The Main Auto Transformer Adjusters inside Control Unit must be connected to Auto taps to match Main Line Voltage.)

TESTING AND CALIBRATION

EQUIPMENT TESTING - MAIN SWITCH should be in "OFF" location also Double Focus Switch moved to "SMALL FOCUS". Turn all such regulators as **FILAMENT REGULATOR** and both Minor and Major Auto Transformer Compensators counter-clockwise to a minimum. For the time being and until adjustment is finally accomplished set Safety Overload Relay, halfway to maximum.

Now replace two Main 60 Amp. Control Fuses and make ready for electrical test by closing Supply Panel Safety Switch which should be conveniently located on the wall.

Turn **MAIN SWITCH** to **RADIOGRAPHY** position and depress **RESET KNOB** of Overload Safety Relay. At this point we recommend throwing *Focus Toggle* to **LARGE** and notice whether filament lights properly then turn back to **SMALL** for further testing. Note, Small and Large Focus Pilot indication. This proves that the small split prong connections at high-tension transformer and tube cathode terminal are making proper contact. Occasionally, it will be necessary to open prongs slightly with knife blade to insure best connection. **CLOSE SHUTTER DIAPHRAGMS SO AS TO EXCLUDE X-RAY TUBE RADIATION FROM THE ROOM WHILE MAKING ELECTRICAL TEST OR INSERT LEAD PLATE INTO CONE SLIDE.)**

Closing the **MAIN Switch** allows the Prereading Kilo-volt Meter and Prereading Filament Ampere Meter to indicate. (Set *TECHNIQUE Regulator* to read 30) and Major and Minor **AUTO-TRANSFORMER** Regulators so that Kilo-volt Meter reads 50 P.K.V. Set timer for one second and depress Timer Exposure Switch with white button and notice reading upon Milliampere Meter Scale. Increase regulator controlling **MILLIAMPERES** by turning slightly clockwise then test exposure and repeat until 30 MA is read upon Milliampere Meter. (Notice Prereading of Ampere Meter, making accurate notation of setting; because this same reading at any future time, with Kilo-volt Meter set at 50 K.V., should preread 30 MA. This reading of 30 MA can be depended upon to remain constant from 29 K.V.P. to 100 K.V.P. due to the fact that the 100-A-2 Control employs a Filament Adjuster Transformer.) An unsteady and

KELEKET TYPE 100-A-2

fluctuating line voltage requires that a filament stabilizer be installed in connection with control unit.

CALIBRATION - The sketch which shows the **LOAD VOLTAGE CALIBRATION** must be checked under the indicated loading 30 MA, 60 MA and 100 MA. Generally, if the 30 MA load voltage chart line checks in terms useful Kilo-volts with prereading of Kilo-Volt Meter indication while **TECHNIQUE** regulator is set on 30 then both the 60 MA and 100 MA will show a comparative reading.

TECHNIQUE SCALE ADJUSTMENT - Place an accurate A.C. Voltmeter across "Y" and one of the heavy 1/4" 20 connections on Overload Relay which will show a certain **NO LOAD** or **PREREADING** voltage. With machine set as above indicated 30 MA and K.V.P. prereading on KV. meter showing 50 K.V.P., make one second exposure on timer and notice where the A.C. meter indicates under **LOAD**. The voltage under this load should show Volts to represent 50 K.V.P. actual kilovoltage as indicated on 30 MA sketch charting. If the load voltage shows 124 Volts, A.C. then the prereading meter kilo-voltage indicated when pressure on push button has been released is not a true value and indicates that **TECHNIQUE SCALE** on Regulator must be moved counterclockwise. The 124 A.C. Load Voltage on sketch shows 47.5 K.V. If **TECHNIQUE KNOB** is moved to new position counterclockwise until Kilo-Volt Meter prereading shows same 47.5 K.V. then this new position represents scale correction to be made.

We suggest two or three other points of the 30 MA sketch Calibration be checked carefully before changing position of scale. Regulate Auto Transformer Major and Minor control to obtain prereading on A.C. Meter of approximately 170 Volts and 210 Volts and notice where Prereading Kilo-Volt meter indicates; for instance 70 K.V. and 89 K.V. Check A.C. load voltage for Kilo-Volt meter Prereading 70 K.V. and 89 K.V. setting which may give 160 Volts Load and 201 Volts. Comparing 160 Volts Load with 30 MA sketch, it shows actual K.V.P. to be 65 instead of K.V. Meter 70 K.V. and 201 Volts load is 85 K.V.P. actual K.V.P. instead of 90 K.V.P. This indicates that 30 MA position on **TECHNIQUE SCALE** must be moved counterclockwise to new position where Prereading Kilo-Voltage at K.V. Meter matches the above 65 and 85 K.V.P. reading. (If however the K.V. Meter is reading below actual calibration then the reverse is true and new position of **TECHNIQUE KNOB AND SCALE** must be advanced clockwise.)

The latest type 100-A-2 Control Unit has the **TECHNIQUE** potentiometer member dropped to a convenient location where the set nut may be loosened and the whole member moved for K.V.P. Meter correction while **TECHNIQUE POINTER** is held on proper Milliampere position. To increase K.V.P. Meter reading simply move potentiometer member counterclockwise. To decrease reading move member clockwise.

The sketch shows connected to one end of potentiometer a 3500 ohm semi-variable resistor attached in series with A - O lead to special auto transformer winding. This is an auxiliary unit which may be employed in conjunction with potentiometer for correction against poor power conditions but generally is never needed. (This 3500 ohm resistor generally is employed in calibrating K.V. Meter in Test Room.)

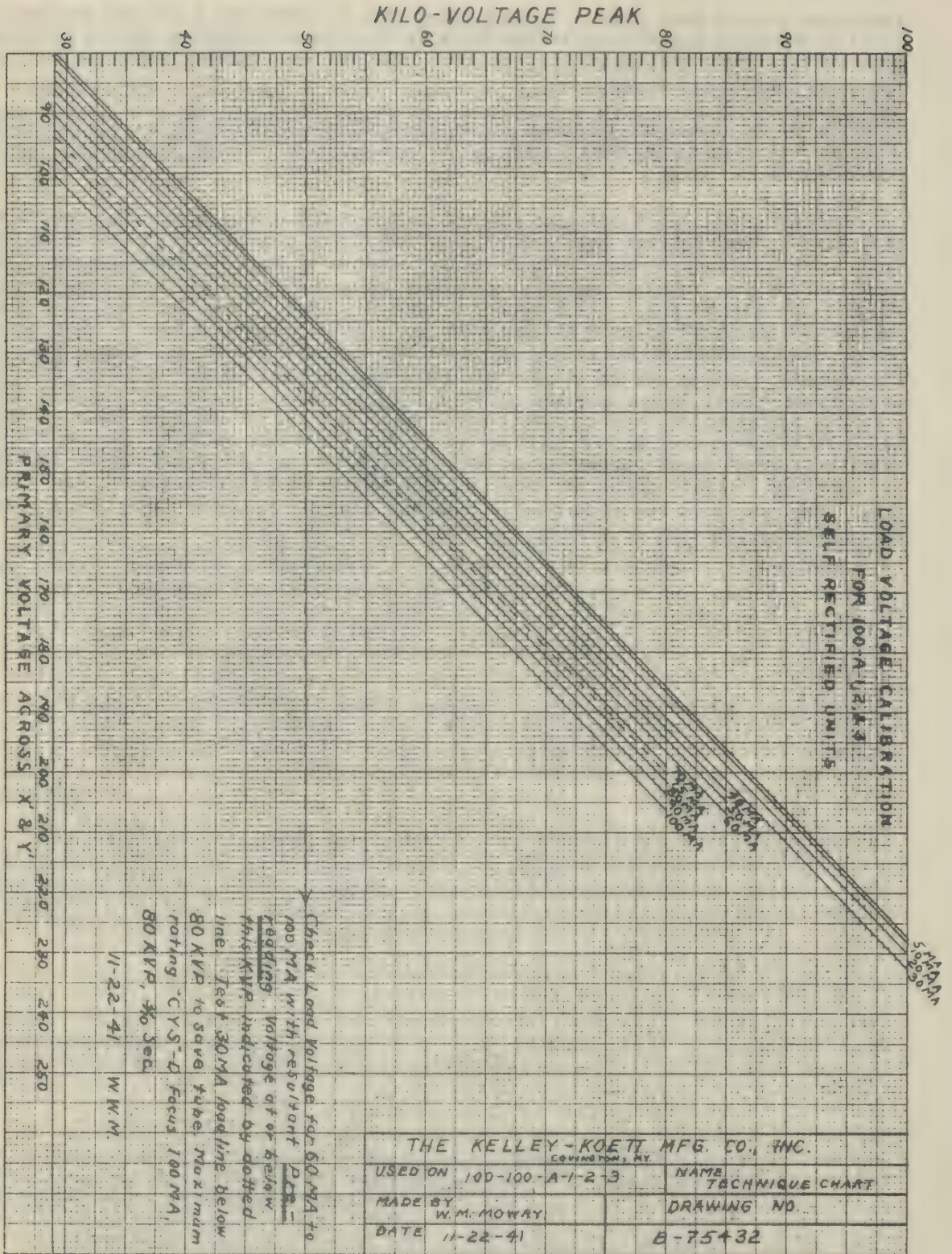
To reset Technique Scale, loosen Knob Set Screw and remove member. Two set screws hold scale in position. Move Scale counterclockwise for correction and tighten screws. Replace knob and recheck in respect to actual K.V.P. derived Load Voltage and Prereading on K.V. Meter.

Generally, when **FOCUS SWITCH** is thrown to **LARGE**, the 60 MA and 100 MA Calibration will check K.V.P. Meter prereading providing the 30 MA settings are proper

excepting on very poor lines. We have found thus far that all a service man has to do is to match as nearly as possible the Auto Transformer Adjusters to the Incoming Line Voltage then Radiograph the patient. (Do not test 100 MA Technique setting excepting for 50 K.V.P. or below.)

The 60 MA sketch Calibration may be checked in a similar manner to the 30 MA procedure by setting TECHNIQUE KNOB on 60 instead of the former 30 setting. (SET FOCUS SWITCH ON LARGE.)

Refer to the sketch *notation* set off to the right. This means that for 60 MA the testing load voltage must not be over 134 Volts and for 100 MA not over 144 Volts. The reason for this procedure is to not over heat the tube target. The Calibrated K.V.P. may be tested against Prereading K.V.P. Meter reading employing above loads for 30 K.V. - 40 K.V. and 50 K.V.P. After these settings have been checked and compared with 30 MA load findings a compromise Technique Scale Setting may be found necessary on very poor lines but results should be checked against radiographic findings before service man turns machine over to the operator. (Check Prereading Ampere Meter reading at 50 K.V.P. Kilo-volt Meter setting and make accurate notation for future presetting of 60 MA and 100 MA loads on LARGE FOCUS). (Also take prereading ampere reading for 30 M.A. on SMALL FOCUS). In the future these Prereading Ampere Meter values undertaken at a constant K.V.P. Meter reading say 50 K.V.P., should preset the milliamperage without further testing of the X-Ray Tube. The reason as stated before is that the Adjuster Filament Transformer holds Milliamperage constant from 29 to 100 K.V.



KELEKET TYPE 100-A-2

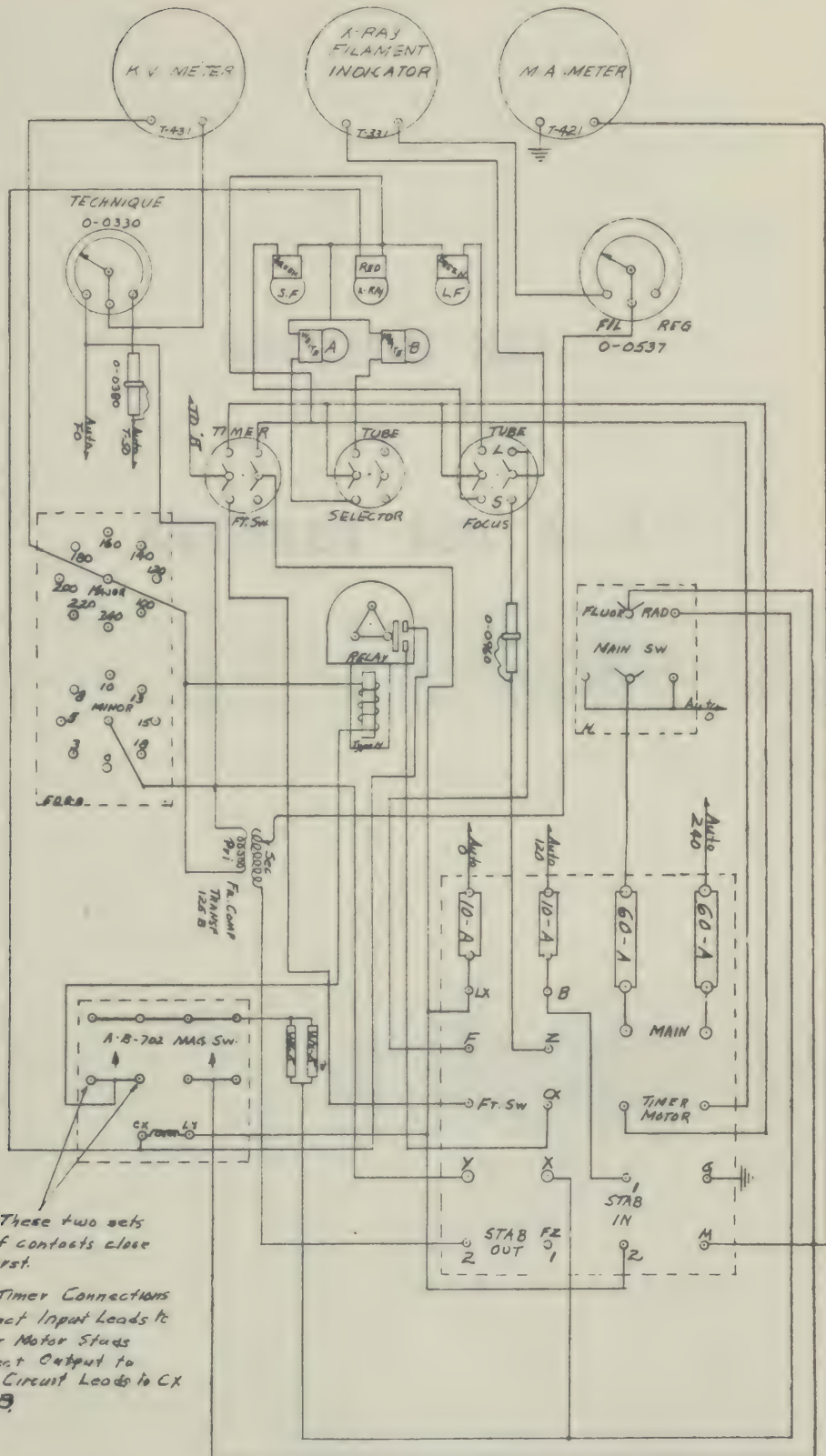
FZ-2 - SMALL FOCUS
FZ-F - LARGE FOCUS

USE

200 L-1 AUTO-TRANSFORMER

WHITE - CX
BLACK - LX
RED - B
SHOWN - G

BUCKY
CONNECTIONS



These two sets
of contacts close
first.

LK Timer Connections
Connect Input Leads to
Timer Motor Studs
Connect Output to
X-ray Circuit Leads to CX
and B.

WIRING DIAGRAM
USED ON TYPE 100-A-2 CONTROL

SECTION XLI

KELEKET 100 - A - 5

SECTION XII

RELEASE 100-A-2

KELEKET TYPE 100-A-5

RADIOGRAPHIC AND FLUOROSCOPIC CONTROL WITH TYPE 100-A-2 (ONE TUBE) TRANSFORMER UNIT

UNPACKING - Care should be taken in unpacking so as not to damage any parts. Check and examine all packing cases so as not to overlook any small parts in packing material. Should there be any parts missing, notify the Supply Officer at once. Special care should be given in respect to handling X-ray tubes and High Tension Cables when included with the shipment.

ELECTRICAL CONNECTION - The Main Service line to accommodate the 100-A-5 Control with the 100-A-2 Transformer should have the following capacity:

TECHNIQUE	LINE VOLTAGE	LINE FUSES	MINIMUM SIZE OF SUPPLY LINES		
100 MA	220 V.A.C.	75 AMP.	200 ft.	100 ft.	50 ft.
80 KVP			#0	#1	#2

#6B.S.G. Stranded Wire should be employed for ground wire. The ground wire should be carried along with the two feeders of proper size as indicated. A substantial water pipe ground is the only acceptable connection. Suggest a Pole Transformer of 15 K.V.A. capacity free from other loads.

It should be noted that in X-Ray Procedure, we are vitally interested in keeping the potential drop in the unit under maximum instantaneous loading, to the lowest possible minimum. This is necessary in order that the Radiographic Technique shall be proper.

Another point to consider is that Self-rectified Half Wave equipment requires power feeders represented by twice the carrying capacity as that employed by four valve or full wave rectified equipment, for the same tube loadings.

The 100-A-2 energizing units and 100-A-5 remote control are designed to operate in connection with regular type shockproof single focus regular or right angle tube. This X-ray unit may be employed in connection with any existing tube stand or radiographic table.

The CONTROL CABLE is generally shipped attached to the 100-A-5 energizing Unit. The standard length cable is fifteen feet long which allows proper positioning of Control Unit of the mobile type.

Refer to sketch which shows complete wiring diagram of Control Circuits. The Control Cable includes the following labeled wires: "FZ", Z and F are primary tube-filament-transformer wires where "FZ" is the Common. Since the unit is for operation of single-focus tube, stud Z is dead and the wires "FZ" and "F" furnish current for the single-focus tube. "X" and "Y" connect to the primary of the High-Tension Transformer. "M" is mid-secondary Milliammeter lead. "G" is Ground connection for Control and Energizing Transformer. ("G" should connect to a thorough water pipe ground.) "G" is also mid-secondary ground connection for Milliammeter. Control panel connections "LX", "A-1" and "A-2" are employed to energize the motor of the motor-driven high-tension switch when one is employed for operation of two X-ray tubes. As this unit is for use with a single X-ray tube, no high-tension switch is supplied and studs "A-1" and "A-2" are not used. An inlet cable may be connected either at the control or at the transformer as there are two heavy wires in the interconnecting cable to allow such a connection.

The BUCKY CONNECTION CABLE is a flexible three wire cable extension with plug end attached at the Bucky Diaphragm. The three lugs are marked "R", "LX", and "B". The code is as follows: White wire connects to "R", Black to "LX", Red to "B".

The FOOTSWITCH cable should be connected to connection post marked Foot Switch

whenever Fluoroscopy is employed.

FILAMENT STABILIZER - A type "S" Filament Stabilizer is furnished with the 100-A-5 Control Unit and mounted inside of the control cabinet. The inlet wires of the stabilizer are connected to studs marked "STAB. IN" #1 and #2, while the outlet wires are connected to studs marked "STAB. OUT" at points shown as #1 and #2. The sketch shows two dotted lines indicating normal connections between "STAB. IN" and "STAB. OUT" when no stabilizer is installed.

The introduction of, or the removal of a stabilizer in respect to the X-ray tube filament transformer primary circuit will definitely change the filament temperature and thus the original milliamperage drawn across the tube. In the event that a stabilizer is either introduced or removed from the circuit, the milliamperage loading of the tube should be tested for each of the settings of the Technique Switch, using a low Kilovoltmeter reading, say 50 PKV or less, so as not to overload the tube during this test.

When the unit is shipped from the factory with stabilizer connected, it is properly installed. We refer in this connection to the "bucking action" which must exist if the so-called "Filament Compensator Transformer" circuit has not been upset by the introduction of the stabilizer. One may watch the Pre-Reading X-Ray Filament Ammeter without the High Tension being applied, and see whether the reading decreases as the auto-transformer setting is increased. This indication proves that the compensator transformer is connected properly in the circuit. A reversal of the Stabilizer Inlet Leads will correct this feature if the Filament Ammeter does not show this bucking action.

INLET - A flexible INLET cable should be connected from properly installed safety type service switch and fuse panel to points on the Control Panel marked "MAIN". (While the machine is being connected and before equipment is to be tested, we suggest the removal of the MAIN 60 ampere Control Panel Fuses.)

AUTO TRANSFORMER ADJUSTMENT - The auto transformer adjustment should match the line voltage measured across contacts marked "MAIN". The sketch shows two AUTO-ADJUSTER LEADS, one marked "AUTO-0" and one marked "AUTO-240" attached to the control Main Switch. Tags are ordinarily attached to the Auto-Adjuster wires to identify them. These Auto-Adjuster wires ordinarily connect to the Auto-Transformer thru the double deck major-minor auto transformer switch. Reference to the sketch will show that the top deck of the Auto Transformer switch has eight taps connecting to the auto transformer at points marked 100, 120, 140, 160, 180, 200, 220, and 240 volts, while the bottom deck has taps going to the auto transformer at points marked 0, 3, 5, 8, 10, 13, 15, and 18 volts. When the machine is shipped, the Auto-Adjuster Leads are attached to 240 on the upper deck and 0 on the lower deck, and thus adjusted for a 240 volt line voltage. Usually the line voltage at the installation differs from this value and it is necessary to change the position of the auto-adjuster leads, so that the difference between the major and minor taps selected is approximately equal to the line voltage. For example, if the line voltage is 230 volts, leave the major auto-adjuster connected to the 240 tap but move the minor adjuster from the 0 tap to the 10 tap giving a difference of 230 which is equal to the line voltage. For a second example, consider the line voltage is 220 volts. In this case leave the minor adjuster connected to the 0 tap and move the major adjuster to the 220 tap giving a difference of 220 which is equal to the line voltage. For a third example, consider the line voltage is 208 volts. In this case it is necessary to move both adjuster leads to get a difference of 208. The major adjuster is moved from the 240 tap to the 220 tap, and the minor adjuster is moved from the 0 tap to the 13 tap giving a difference of 207 which is the nearest

obtainable to the line voltage of 208 volts. By selecting in a manner similar to the above examples, the proper taps on the major and minor switch, it is possible to match the line voltage within plus or minus one volt. If it is found that the line voltage fluctuates from time to time, such a value for the line voltage should be selected as will represent the average value during the period when the unit will be in operation most frequently. In case the line voltage is greater than 240 volts, it will not be possible to find a combination on the Auto Transformer Switch contacts that will match the line. In this case, the adjuster lead going to the major deck (and connected to 240 when it leaves the factory), is disconnected from the switch and brought directly to the auto transformer for connection to an extra tap marked 250 which is provided on the auto transformer for this purpose. Either a good solder connection should be made or an approved type solderless connector used which will assure adequate and proper contact. This extra 250 volt tap extends the range up to a line voltage of 250 volts but voltages in excess of this should not be used.

FILAMENT COMPENSATOR TRANSFORMER CIRCUIT - The primary of this transformer unit is shown in the sketch to the right and below the Minor Auto Regulator, while the secondary is shown to the right of Technique Selector Switch. This unit is to hold the Milliamperes constant for any tube current over a voltage range from 20 KVP to 100 KVP. The primary is connected across the wires extending from Major and Minor Auto Transformer Levers or central connections. The Secondary which is adjustable for use with all types of X-ray tubes is placed in Series with X-Ray Tube filament regulating circuit. As the Auto Transformer setting is increased, the voltage in the X-Ray Tube Filament Circuit is decreased just enough to allow the cathode stream, therefore the Milliamperes across the tube, to remain constant. Tube saturation takes place around 80 KVP and at this point the magnetic flux of Compensator Transformer has increased to a maximum and corrective action stops. This effect will be noticed on Pre-Reading Ampere Meter. The proper taps of the secondary of the Filament Compensator Transformer are connected thru one deck of the Technique Selector Switch to the Filament Transformer Circuit. These secondary taps on the Filament Adjuster Transformer are properly selected at the factory at the time of wiring the control for the fixed milliamperage values set up on the Technique Selector. If for any reason a different set of the milliamperage settings should be made later, a new set of Filament Adjuster Transformer taps must be selected.

TECHNIQUE SELECTOR SWITCH - This device consists of a four-deck, six-position switch adjusting and interlocking certain circuits in the control so as to obtain certain definite fixed milliamperages by means of the SINGLE OPERATION of this switch. To accomplish this, the four decks of the switch are employed in the following manner. Referring to the sketch, the four decks of the switch are shown in the upper right corner.

The upper deck of this switch is used to adjust the potentiometer circuit of the Pre-Reading Kilovoltmeter so as to automatically correct its readings for the different milliamperage loadings. This potentiometer is interconnected with the auto transformer levers and special independent auto transformer winding shown on sketch as T-0 and T-50.

Similarly, the six straps on the 50 ohm variable resistor, which are connected to the top deck of the Selector Switch, should ordinarily need no further adjustment. However, included with these instructions is a set of graphs indicating Load Voltage Calibration. If it is suspected that the Kilovoltmeter does not read properly under one or more of the milliamperage settings, its readings can be checked. A precision voltmeter should be connected to X and Y and a reading taken *UNDER LOAD*

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and reference made to the proper line on the graph. The Kilovoltage indicated should correspond to the *PRE-READING Kilovoltage* indicated by the control kilovoltmeter. Should a discrepancy occur, it is possible to move the corresponding strap on the potentiometer resistor until the control Kilovoltmeter does read the proper value. More complete instructions for making this adjustment will be given later.

The second deck of the Technique Selector Switch is used to adjust the filament temperature of the X-ray tube. The 100 ohm and the other 50 ohm resistor, each with four straps, accomplish this. Upon installation, it is usually necessary to adjust these straps so as to obtain the proper milliamperages. These adjustments should be made at voltages just under 50 PKV so as not to damage the X-ray tube. The Filament Compensator Transformer will make these adjustments valid for higher or lower voltages.

The third deck of the Technique Selector Switch is used to select the proper tap of the Filament Adjustor Transformer Secondary. The fourth deck selects the proper scale on the double scale milliammeter, the relay marked "REM" selects the high scale on the 30, 60, 75, and 100 MA settings and the low scale on the 5 and 10 MA settings. This deck has the additional function on the 5 MA setting of introducing the Footswitch into the circuit.

In fact, the footswitch circuit is open except in the 5 MA position. Also in the footswitch circuit, is a double-pole double-throw toggle switch mounted on the control panel and marked "Foot Switch". When this toggle is thrown on the footswitch side, the pilot light is turned off and the footswitch is introduced into the circuit. When the toggle is thrown in the opposite direction the footswitch circuit is opened and the pilot light is energized. It should also be noted that the 5 MA position introduces a resistance type filament regulator into the filament circuit so that fine adjustment of this milliamperage may be used. It provides a range of approximately 3 to 10 MA.

The Technique Selector Switch on this control is ordinarily arranged for the following milliamperages 5, 10, 30, 60, 75, and 100 MA. The size of the focal spot in the tube will determine which of these milliamperages will be used. If a "C-plus" single focus tube is employed, then 100 MA should not be employed except on single P.A. 72" Chest procedure unless the kilovoltage for the indicated centimeter depth will allow a stereo pair. (SEE TUBE RATING CHART)

TUBE SELECTOR TOGGLE SWITCH - As this unit is for operation of a single X-ray tube, this switch is strapped out so as not to interfere with the operation of the unit.

MAGNET SWITCH - This switch is air type gravity controlled and interrupts the primary voltage to X. There are two sets of contacts in the switch, each of which contain four poles. When the magnet is energized, opposite poles in the two sets of contacts are connected together. In wiring the switch, one set of contacts are strapped together and connected thru a surge resistor to X and also to the radiographic side of main switch. The other set of contacts are divided into two groups of two contacts each strapped together. One pair of these contacts connect thru the overload relay to the Major Auto Lever and the other pair connect to the Main Switch. The function then, is that when the main switch is turned to the Radiographic position, the surge resistor is shorted out and when the main switch is turned to the Fluoroscopic position, the current reaching X must pass thru the surge resistor.

TIMER - The synchronous motor-driven timer is #3626 Keleket "LK" Timer; it

is installed and mounted on shelf behind the meters.

This synchronous motor timer produces exposures from 1/10 sec. to 14 sec. The first second is divided into 1/10 second divisions. The rest of the Timer Dial is divided into 1/4 seconds although a setting for every 1/8 seconds may be obtained by setting between divisions.

Connections are indicated on rear of Timer case. Facing rear of timer, connect the first set of wires to *Timer Push Switch* (having white button). Second set of wires "INPUT" are to be connected to the 115V .25 amp. supply which is "B" and "LX" on Control Connection Panel. Third set of wires marked "OUTPUT" to X-Ray Relay connect to "B" and "CX" on Connection Panel. (Drawing B-19252-2 shows method of connecting Bucky Diaphragm to allow timer to directly accomplish Bucky exposure. Bucky setting must therefore, be increased above desired exposure.)

METERS - The three primary meters are mounted at the rear of control panel. From left to right will be found the Double Scale *Milliammeter*, the Pre-reading X-ray tube *Filament Ammeter*, and the Pre-Reading *Kilovolt Meter*. In respect to the change in scale of the Milliammeter, this is accomplished thru position of Technique Selector Switch and intermediate relay allowing 5 and 10 MA on Low Scale and 30, 60, 75, and 100 on the High Scale.

AUTO TRANSFORMER - This voltage adjuster is a 64 step Regulator with eight Major and eight Minor steps. The adjuster is a combination Regulator employing Lever Handle for adjusting Major steps and Knob mounted centrally for Minor Selection. (No cognizance is made of Auto Transformer Dial markings as regulators are turned until certain Pre-Reading Kilovolt Meter indication is derived.)

MAIN SWITCH - The Main Control switch consists of a three-pole double-throw heavy-duty switch breaking both sides of the line and selects between Fluoroscopy and Radiography. As indicated under "Magnet Switch", it introduces primary resistance when thrown to the Fluoroscopy-Therapy setting.

RELAY - This is the standard adjustable Overload Relay. An arbitrary dial scale is employed where increased load adjustment is accomplished in clockwise motion. When reset knob is lifted either manually or electrically, the Main Magnet Relay Switch circuit is opened which stops all energy from flowing across X-Ray Tube. When installation is being accomplished, this adjustable safety relay should be set at a point which will not allow Reset Knob to stay depressed if a Tube loading exists above 100 MA at 80 KVP. One tenth second timer exposures should be employed to determine this point (waiting three minutes between exposures so as not to harm the X-ray tube). Suppose that the proper overload setting has been determined and during future operation the Reset Knob releases electrically, then do not reset knob until source of trouble has been eliminated.

TESTING AND CALIBRATION

TESTING UNIT - Make sure that the Control Main Switch is in the "OFF" Position and both Major and Minor Auto Transformer Regulator switches are turned counter clockwise to their minimum positions. For the time being set overload Relay Adjustment about half-way to maximum, and pull out the Overload Relay Knob. Set the Technique Selector Switch to the 5 MA position. Now close the Main Service Switch and then turn the Control Main Switch to Fluoroscopic position. Check the following items:

1. Note whether the X-Ray Filament Indicator shows a deflection.
2. Check to see if the filament in the X-ray tube is lighted. In case the

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filament is not lighted, check the high-tension cable cathode connections to tube and transformer.

3. Turn the Filament Regulator Knob back and forth and note whether the Filament Indicator Meter responds. The filament regulator is in the circuit on the 5 MA technique but is removed from the circuit on all other milliamperage settings.

4. With the Control Main Switch on the Fluoroscopic position, Footswitch Toggle to ON position, push in Overload Relay Knob and step on Footswitch. The Milliammeter should indicate that the X-ray tube is passing current. Turn the filament regulator to minimum position and then to the maximum position and note the reading of milliammeter.

The range of these settings should be approximately from 3 MA to 10 MA when the pre-reading kilovoltmeter is made to read around 50 PKV. Actually the filament compensation transformer adjusts the filament temperature so as to maintain a constant milliamperage in going from the lowest to the highest kilovoltage. In case the filament regulator does not cover the desired range (and usually it does not since no attempt is made to set it at factory unless the tube to be used with the unit is tested with it at the factory), adjust the position of the 5 MA strap on the 100 ohm filament resistor mounted at the upper rear in control cabinet. (Usually it is the center of the three tall resistors mounted in the cabinet.) In making this adjustment, usually it is best to set the filament regulator at about its mid position and adjust the strap until the meter reads 5 MA. CAUTION: DO NOT ATTEMPT TO ADJUST POSITION OF STRAPS ON THE RESISTORS OR MAKE ANY OTHER ADJUSTMENTS INSIDE THE CONTROL WITHOUT FIRST TURNING THE CONTROL MAIN SWITCH TO THE OFF POSITION. An accidental short with a screw driver or pliers might burn out the tube filament.

After adjusting the 5 MA setting of the Technique Selector Switch, proceed with adjustment of the 10, 30, 60, 75, and 100 MA settings at 50 PKV. Turn the Main Switch to the Radiographic position. Turn the Technique Selector Switch to the successive settings, at the same time observing the filaments of the X-ray tube. The filament should be lighted at each position of the Technique Switch. The 10 thru 75 MA settings are to be allowed for normal exposures and 100 MA in selected cases as allowed by the Tube Rating Chart. Set the Technique Selector on the 10 MA position and adjust the Auto Transformer Switches for approximately 50 PKV as indicated by the Pre-Reading Kilovoltmeter. Set the timer for 2 seconds and make exposure observing the milliammeter. Adjust the 10 MA strap on the resistor at the back in control, until exactly 10 MA is obtained.

In a similar manner set 30, 60 and 75 MA positions of Technique Selector. The rating chart for the radiographic tube should be consulted before setting the 100 MA setting to determine the length of exposure possible for this current at 50 PKV. If necessary reduce the kilovoltage to a safe value for exposure long enough to read milliammeter. (SEE TUBE RATING CHART.)

After setting the milliamperages at 50 PKV, select say, 60 MA setting and test at 30 PKV and at 70 PKV to determine if change in kilovoltage caused any change in milliamperage and hence whether the Filament Compensator Transformer is functioning properly. Care should always be exercised so as not to exceed rating of tube. In testing with a new tube it is advisable to always stay within two-thirds the tube rating as given by the tube manufacturer. This refers both to the MA-PKV-Time focal spot rating and to the total heat storage capacity of the anode.

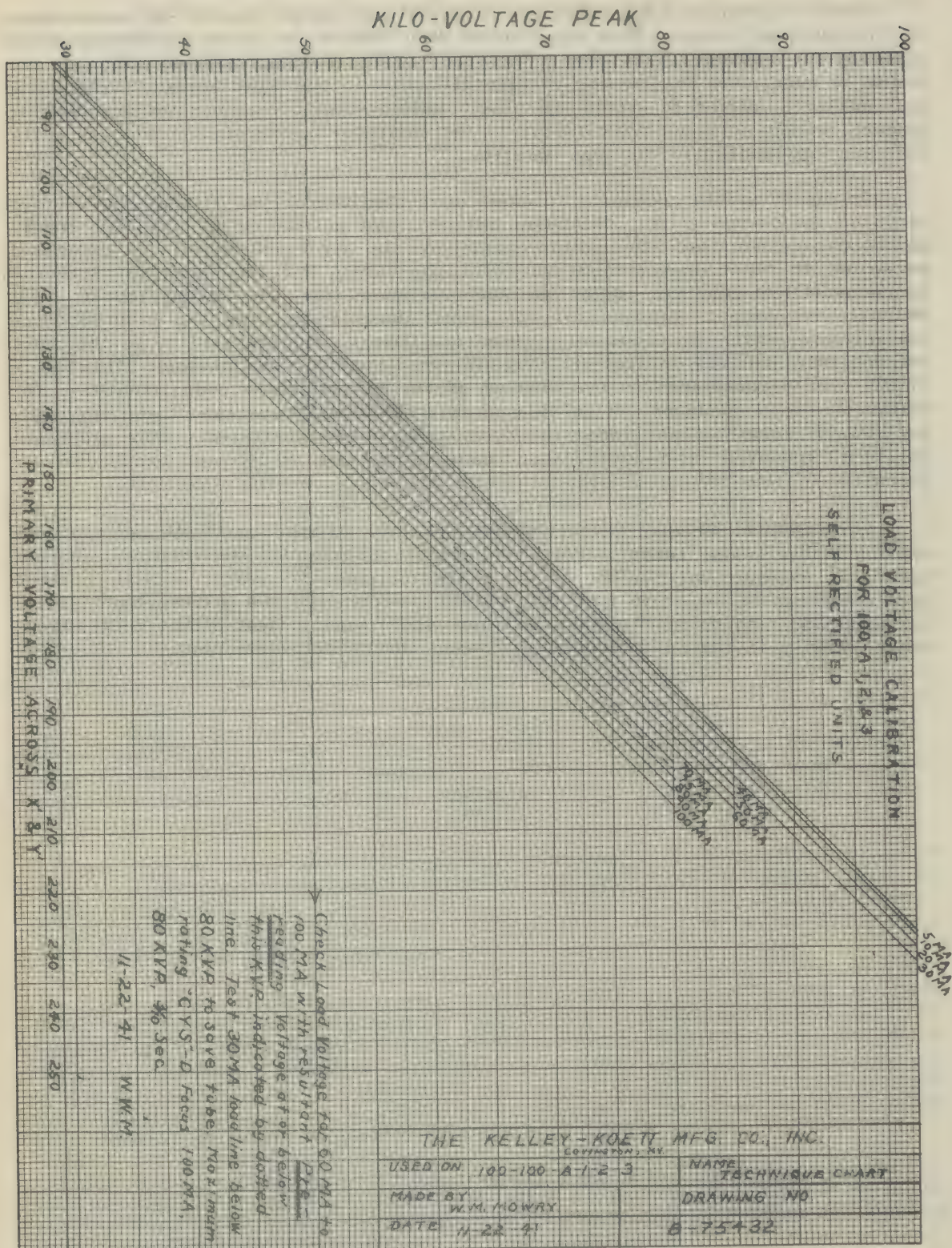
The unit is calibrated for a satisfactory power line such as is specified on the first page of these instructions. If there is some reason to check the calibration it may be accomplished by means of the sketch LOAD VOLTAGE CALIBRATION GRAPH attached to these instructions. The following procedure should be followed:

Place an accurate A.C. voltmeter across "Y" and one of the 1/4"-20 connections on the overload relay. When the control Main Switch is turned to Radiographic position the voltmeter will show a "No-Load" or Pre-reading voltage. When an exposure is made, this pre-reading voltage will drop to the "Load Voltage" value. As most accurate voltmeters attain the final reading slowly, the Load Voltage reading is more quickly attained by the meter if the indicator has to move only a few volts from the Pre-Reading to the Load position.

It should not be necessary to check more than one or two of the Load Voltage lines on the sketch graph. One might select 10 MA and the 60 MA lines for check. Before making the test, the rating charts for the X-ray tube should be consulted so as not to cause damage by overloading the tube. Set the Technique Selector to the milliamperage and adjust the Auto Switch so that the Kilovoltmeter reads 30 PKV. Now make an exposure of sufficient duration to read the LOAD VOLTS on the voltmeter while the exposure is going on. Consult the proper line on the chart and determine the PKV indicated by the observed *Load Voltage Reading*. This value of PKV should correspond to the reading of the Kilovoltmeter under NO-LOAD. The Kilovoltmeter is designed and calibrated as a PRE-READING instrument and its reading should always be taken when the X-ray tube is not energized. This procedure should be repeated for kilovoltmeter readings of, say, 50 PKV and for 70 PKV. A check for higher PKV may be made if within the rating of the X-ray tube.

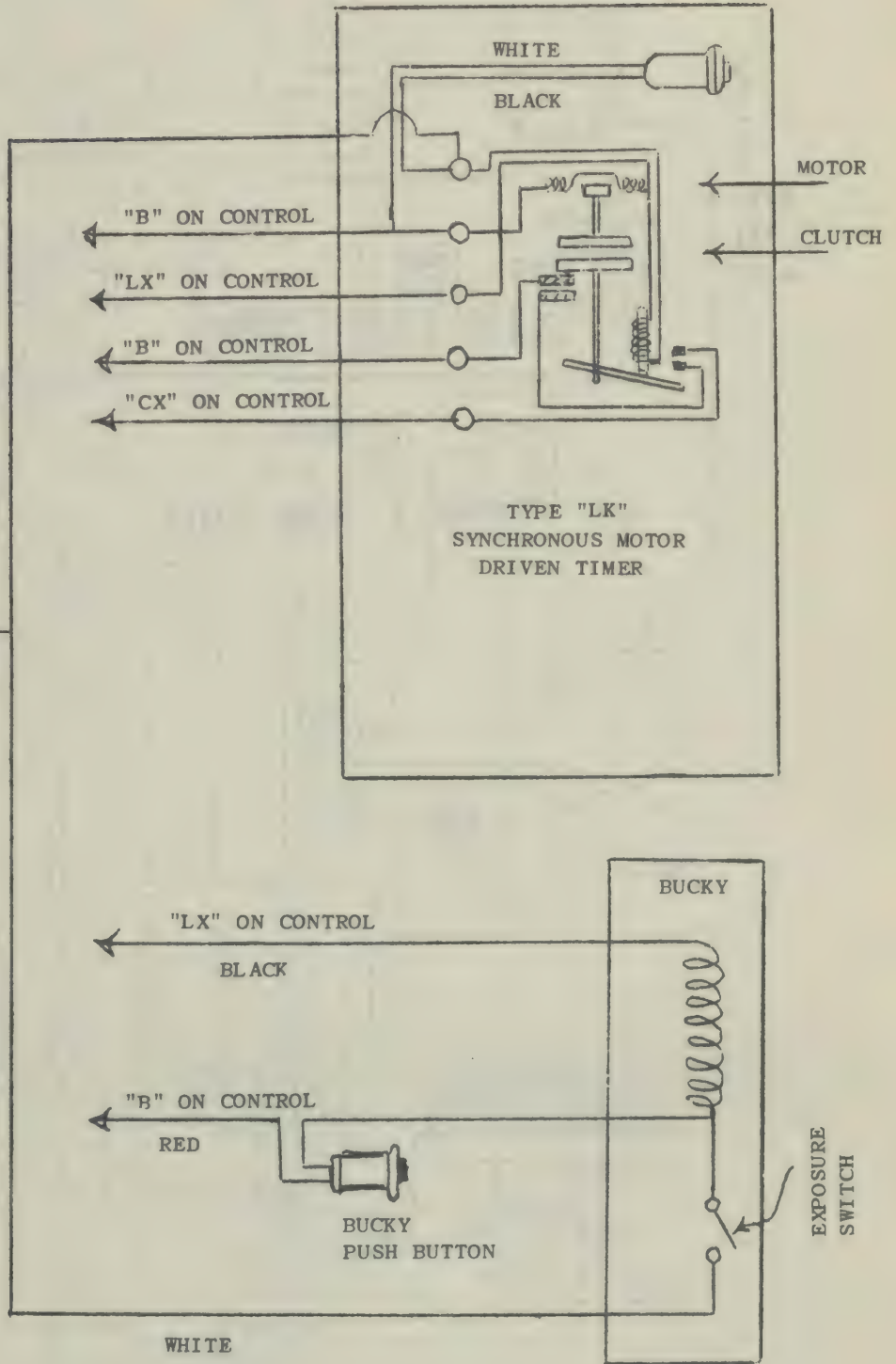
For example, suppose the Technique Selector is set for 60 MA and the pre-reading Kilovoltmeter reads 50 PKV. An exposure is made and the voltmeter is read during the exposure under LOAD. If the voltmeter reads 134 volts, it will be found upon referring to the graph that this checks exactly with the calibration. If the voltmeter had read only 130 volts, the graph would have indicated that this corresponds to only 48 PKV and the unit is coming thru 2 kilovolts low.

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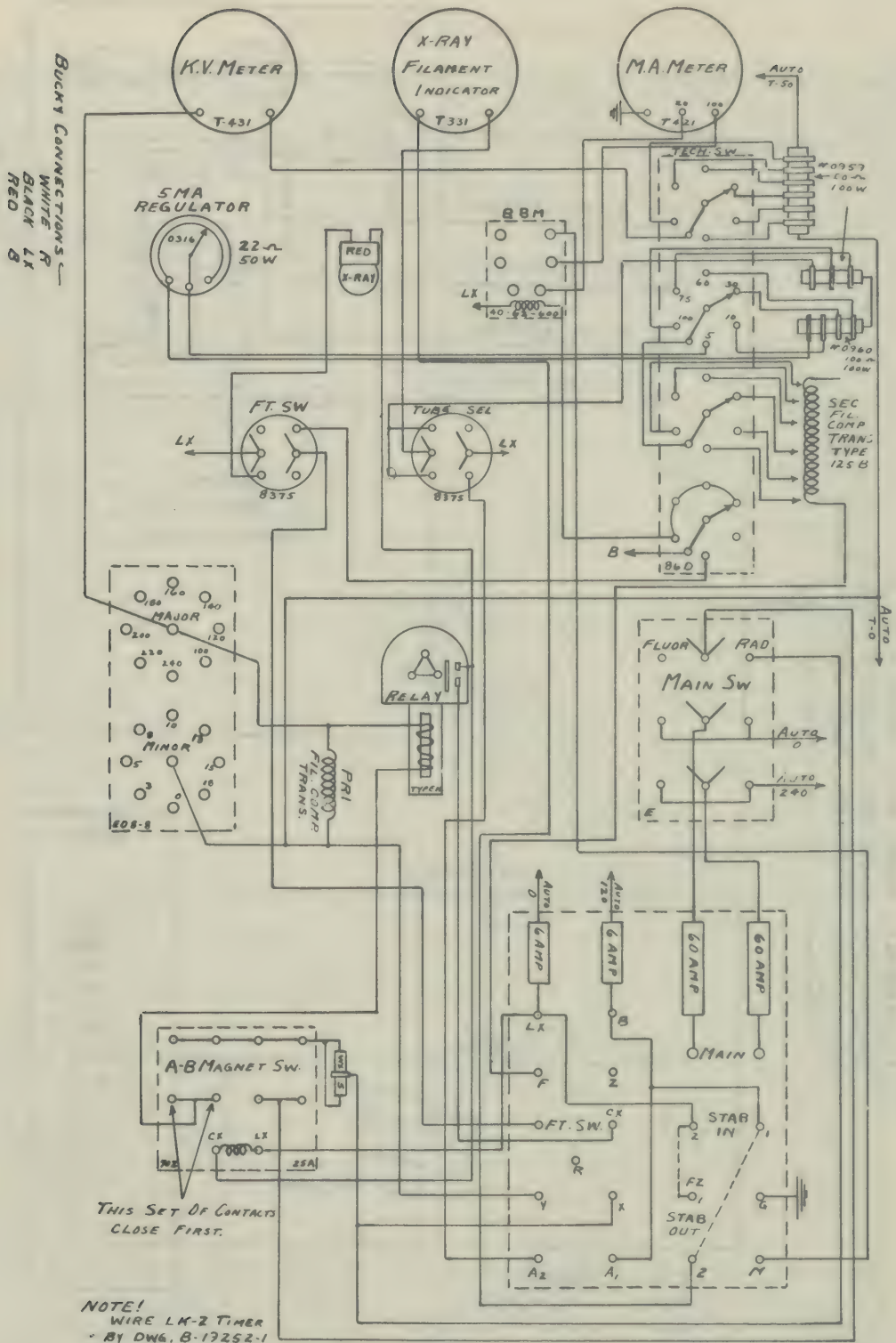
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IF POSSIBLE, BRING WHITE BUCKY WIRE TO
UNUSED STUD ON CONTROL PANEL AND THEN TO
TIMER PANEL; OTHERWISE SOLDER AND TAPE LEADS.



Drawing # B-19252-2

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SECTION XLII

100 MA UNIT - W

100 MA UNIT (W)

UNPACKING - Carefully unpack the various boxes and crates in which the equipment is received and examine it for possible damage.

POWER REQUIREMENTS

Volts:	200 to 250	Frequency:	60 Cycles
Amperes:	80 (Maximum)	Phase:	1

WIRING - The equipment may be connected either by means of the interconnecting cables provided, or by running the necessary number of conductors thru conduit. If the latter method is used, the following are the number of conductors and wire sizes required.

Wire sizes for the various conductors *between the control and the high-tension transformer* when run in conduit.

Number of Conductors	Wire Size	Connect to Terminals
2	#6	A, AA
1	#8	G
4	#14	XFC, XFS, XFL, MA

(These are the minimum requirements for the apparatus indicated, and it is advisable to run at least four extra #14 wires to provide for future additional equipment).

Wire sizes for the various conductors *between the control and the power supply line* when run in conduit.

Number of Conductors	Wire Size	Connect to Terminals
2	#6	L-1, L-2
1	#8	G

Wire sizes for the various conductors *between the control and table* when run in conduit.

GENERAL DESCRIPTION - Before attempting to install or operate the apparatus, the following should first be carefully read so that the functions of the various parts and controls will be thoroughly understood.

CONTROL

1. **MAIN SWITCH** - The main switch, located on the front of the control body controls all power to the primary circuits. When set to the "OFF" position it disconnects the main feed line from the apparatus. When set to the "ON" position, the autotransformer is energized, the x-ray tube filament lights, and all circuits, with the exception of the high-voltage circuit, become alive. This switch embodies a thermally operated overload circuit breaker which automatically cuts off all current in case of overload.

Should the switch ever trip off automatically due to overload, it can be reset as follows:

- Allow about 20 seconds for the thermal element within the switch to cool.
- Push switch lever firmly to the "OFF" position.
- Then push lever to "ON" position.

When x-rays are not being generated, it is recommended that this switch be

kept in the "OFF" position in order to avoid burning the x-ray tube filament unnecessarily.

2. **POTENTIAL CONTROLS** - The high-voltage output of the high-tension transformer is controlled by means of the two potential dials.

The coarse control on the left varies the kilovoltage in seven steps of 10 kv each. The fine control on the right varies the kilovoltage in eleven steps of 1 kv each.

The coarse and fine controls together combine to give regulation in 1 kv steps over the entire range of the equipment (30 to 100 kv).

The potential dials should never be adjusted without making the necessary corresponding adjustment of both the line voltage regulator and calibration control as called for by the calibration chart on the last page of these instructions. When so set, they indicate fairly accurately, the actual output of the high-tension transformer in kilovolts. **FAILURE TO PROPERLY ADJUST THE LINE VOLTAGE REGULATOR AND CALIBRATION CONTROL, PARTICULARLY AT THE HIGHER KILOVOLTAGE SETTINGS, MAY RESULT IN DAMAGE TO THE TRANSFORMER, HIGH-TENSION CABLES OR X-RAY TUBE. ADJUSTMENT OF THE POTENTIAL CONTROLS SHOULD NEVER BE MADE WHILE THE X-RAY CIRCUIT IS ENERGIZED.** (See paragraphs 3 and 4 on line voltage regulator and calibration control.)

3. **LINE VOLTAGE REGULATOR** - The line voltage regulator provides a means for conveniently and quickly adjusting the autotransformer in the control so as to compensate for minor variations in line voltage. In use, it is adjusted, **WITH THE VOLTMETER BUTTON DEPRESSED**, until the control line-voltmeter needle points to zero. This adjustment is the basis for the calibration control setting and unless it is properly made, will throw off the entire calibration of the equipment. If difficulty is experienced in getting the control line-voltmeter to read zero (**WITH VOLT-METER BUTTON DEPRESSED**), it is an indication that the line voltage selector strip on the control terminal-panel has not been properly set. **ADJUSTMENT OF THE LINE VOLTAGE REGULATOR SHOULD NEVER BE MADE WHILE THE X-RAY CIRCUIT IS ENERGIZED.** (See paragraph 6 on Line Voltage Meter.)

4. **CALIBRATION CONTROL** - The calibration control provides a means for adjusting the autotransformer so that the actual high-tension transformer secondary voltage will agree with the values shown on the potential dials for all milliamperage settings, when x-rays are turned on.

Its various positions are indicated on the arbitrary scale of the line-voltmeter, and it should be preset only in strict accordance with the calibration chart furnished with the equipment. All settings given are based on "no load" values, i.e., before x-rays are turned on. **ADJUSTMENT OF THE CALIBRATION CONTROL SHOULD NEVER BE MADE WHILE THE X-RAY CIRCUIT IS ENERGIZED.** (See paragraph 6 on Line Voltage Meter.)

5. **FILAMENT REGULATOR** - The dual filament regulator is a stepless induction type control which increases or decreases the x-ray tube filament current, which in turn raises or lowers the milliamperage flowing thru the high-voltage circuit of the tube. The upper, or small knob controls the x-ray tube filament during radiography; the lower or large knob controls the x-ray tube filament during fluoroscopy. Turning the controls in a clockwise direction increases filament current; turning them in a counter-clockwise direction decreases it. During fluoroscopy, only the fluoroscopic control is in the circuit. During radiography, only the radiographic

control is in the circuit. When increasing milliamperage, the controls should be turned slowly so as to avoid the application of excessive currents to the x-ray tube. BEFORE CONNECTING THE EQUIPMENT TO THE POWER LINE, MAKE CERTAIN THAT BOTH FILAMENT REGULATORS ARE TURNED AS FAR IN A COUNTER-CLOCKWISE DIRECTION AS THEY WILL GO. FAILURE TO TAKE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE X-RAY TUBE FILAMENT WHEN THE MAIN SWITCH IS TURNED ON. (See Par. 7 on Filament Meter.)

6. LINE VOLTAGE METER - The 0-6 line-voltage meter on the right side of the control panel is a dual purpose voltmeter with an arbitrary scale. When used in conjunction with the line voltage regulator setting, the small black voltmeter button on the left side of the control must be depressed and held down. The line voltage regulator is then adjusted until the meter reads zero (0).

When used in conjunction with the calibration control setting, the calibration control is adjusted (WITHOUT DEPRESSING THE VOLTMETER BUTTON) until the meter reads the value called for on the calibration chart for the particular kilovoltage and milliamperage selected. (See Par. 3 and 4, on Line Voltage Regulator and Calibration Control.)

7. FILAMENT METER - The 0-10 filament meter which is controlled by the filament regulators, is an ammeter with an arbitrary scale connected in the primary circuit of the x-ray tube filament transformer. When the control main-switch is turned on, the meter will read the current flowing thru the x-ray tube filament circuit in arbitrary values. Since the milliamperage flowing thru the high-voltage circuit of an x-ray tube is, for a given voltage, a direct function of filament temperature, the filament meter provides a means for indirectly indicating in advance, the milliamperage which will be obtained when the x-ray tube is energized. Increasing the filament current raises the milliamperage; decreasing the filament current lowers it.

After the equipment is installed, a careful record should be kept of the filament meter readings for the various milliamperage and kilovoltage settings, on the chart provided. Such a chart simplifies the process of presetting the equipment for a desired milliamperage before x-rays are turned on, and contributes much toward longer tube life by making constant preliminary testing before an exposure unnecessary. Since all x-ray tubes, even those of the same type, differ slightly in their filament characteristics, the filament meter values shown at the end of these instructions are of necessity only approximate and should be rechecked in the field at the time the equipment is installed.

8. MILLIAMMETER - The milliammeter furnished with this equipment, and located on the left of the control panel is a D.C. instrument with two scales. When the equipment is set for fluoroscopy, the lower or 0 to 10 milliamperage scale is automatically connected into the circuit. When the equipment is set for radiography, the upper or 0 - 100 milliamperage scale is automatically connected into the circuit. However, if it is desired to use a value of 10 milliamperages or less on radiographic work, the 0 to 10 Ma scale can be momentarily cut into the circuit by pressing and holding down the small black MILLIAMMETER BUTTON located directly under the meter. DO NOT PRESS THE MILLIAMMETER BUTTON IF THE CURRENT IS IN EXCESS OF 10 MILLIAMPERES - A BURNED OUT METER MAY RESULT.

9. INSTRUMENT ILLUMINATION - Instrument illumination is provided by means of the meter light located directly below the three meters, and the potential-dial light located on the sub-panel directly underneath the two potential dial windows.

Replacement bulbs are identified by the manufacturer as No. 36-626.

10. **LIGHT SWITCH** - The toggle switch marked "LIGHTS" controls the illuminating circuits. All illuminating lights should be turned off when not required. This switch does not affect the red indicator lights.

11. **FOCUS SELECTOR SWITCH** - The toggle switch marked "FOCUS" provides a means for selecting either the large or small focal spot of the x-ray tube when the equipment is to be used for radiography. The switch becomes inoperative during fluoroscopy.

The two small red pilot lights, which indicate on which focal spot the equipment is operating, are wired in series with the primary circuits of the two x-ray tube filament transformers. Should either one of them fail to light when the focus selector switch is thrown, and the bulb itself has not burned out, it will be an indication of either a burned out x-ray tube filament, or an open circuit elsewhere in the filament circuits.

WHEN REPLACING THESE BULBS, IT IS OF THE UTMOST IMPORTANCE THAT BULBS OF THE SAME TYPE AS THOSE FURNISHED WITH THE EQUIPMENT BE USED. FAILURE TO TAKE THIS PRECAUTION MAY UPSET THE FILAMENT CIRCUITS. When ordering replacement bulbs refer to Westinghouse Style #980218-A Mazda lamp No. 64 - 3CP - 6 to 8 volts - G-6 - D.C. Base.

12. **FLUOROSCOPIC-RADIOGRAPHIC SWITCH** - The toggle switch marked "fluoroscopy" - "radiography" provides a means for quickly and automatically setting the equipment for one or the other.

With the switch in the fluoroscopic position, the small focal spot of the x-ray tube, fluoroscopic filament regulator, footswitch and low (0-10) scale of the milliammeter are cut into the circuit.

The hand push-button, Bucky, timer, and focus selector switch are all inoperable during fluoroscopy.

With the switch in the radiographic position, either the large or small focal spot (depending on which one is selected) of the x-ray tube, the radiographic filament regulator, hand push-button, Bucky-Timer switch, focus selector switch, and high (0-100) scale of the milliammeter are cut into the circuit.

The footswitch and fluoroscopic filament regulator are inoperable during radiography. The low (0-10) scale of the milliammeter is also out of the circuit unless the milliammeter button is pressed. DO NOT PRESS THE MILLIAMMETER BUTTON IF THE CURRENT IS IN EXCESS OF 10 MILLIAMPERES.

13. **TIMER-BUCKY SWITCH** - The toggle switch marked "Timer-Bucky" provides a means for selecting either the timer or the Bucky when the equipment is to be used for radiographic work. It is inoperable during fluoroscopy. With the switch in the "Timer" position, the radiographic exposure is controlled by the timer and the push-button.

With the switch in the "Bucky" position, the bucky is released by the push button and the exposure is timed by the timer.

14. **CONTROL TERMINAL IDENTIFICATION** (See drawing 2-B-8573) - As a rule

all control terminals which connect to the high-tension transformer are identified to correspond to similar markings on the transformer terminals. In instances where such is not the case, special instructions are provided.

- (a) The six heavy studs arranged in an arc and marked 200, 210, 220, 230, 240 and 250 volts are the line voltage selector terminals. These provide a means for adapting the equipment to various line voltages. After the line voltage has been determined by means of an accurate AC voltmeter, the line voltage selector strap should be connected to the terminal whose value corresponds closest to the indicated voltage.
- (b) The XFC stud is the "common" x-ray tube filament transformer terminal. It is common to both the XFS and the XFL terminals.

The XFS stud is the "small focus" x-ray tube filament transformer terminal.
The XFL stud is the "large focus" x-ray tube filament transformer terminal.
- (c) The CC, and C-2 studs are the Hand Push Button terminals.
- (d) The MA stud is the milliammeter terminal. The other side of the milliammeter connects to ground within the control.
- (e) The BC and BMC studs are the Bucky contact terminals.
- (f) The BM and BMC studs are the Bucky magnet terminals.
- (g) The SM-1, SM-2 terminals provide a separate source of 115 volts AC for use on external accessories. The maximum capacity of this circuit is 10 amperes and the total connected load should never exceed this value. No current supply is available from these terminals when the control main-switch is set to its "OFF" position. Consequently, any equipment which is required to operate when the control is shut down should not be connected to these terminals.
- (h) The CB-1 and CB-3 studs are the microtimer contact terminals. The B and CB-2 studs are the microtimer synchronous motor terminals. The CB-2 and CB-3 studs are the microtimer clutch terminals.

If it is desired to use an L.F. synchronous timer in place of the microtimer, connect it to the above terminals as follows:

PB, AG on L.F. timer to B on control.
TC on L.F. timer to CB-1 on control.
AC on L.F. timer to CB-2 on control.
TC, PB on L.F. timer to CB-3 on control.

- (i) The FS, FS studs are the fluoroscopic footswitch terminals which connect to the x-ray table.
- (j) The RL, RL studs are the room light terminals to which a fluoroscopic "accommodation light" can be connected if desired. They supply no voltage but merely function as a supplementary switch to open and close a circuit. The circuit is closed when x-rays are off, and open when x-rays are on. Since the light will continue to burn even after the control has been turned off, an additional room switch should be provided in series with the circuit.

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- (k) The heavy L-1, L-2 studs are the power supply terminals and connect directly to the main line.
- (l) The heavy A, AA studs are the high-tension transformer primary terminals.
- (m) The heavy G stud is the ground terminal.
- (n) The four IN, OUT, IN, OUT, studs, which are tied together in pairs by two jumper straps when the control leaves the factory, provide a convenient means for connecting a filament stabilizer to the equipment should local power line voltage fluctuations make its use advisable. The S#979994 filament stabilizer, which is available as an additional accessory, should be connected as shown on wiring diagram 2-B-8573, *after first removing and discarding the two jumper straps.*

When no stabilizer is used, the upper IN terminal should be connected to the upper OUT terminal, and the lower IN terminal to the lower OUT terminal by means of the two jumper straps provided. Good electrical contact should be maintained between the straps and terminals at all times so as to avoid erratic filament operation. Removal of either of the straps, unless a stabilizer is used, will result in an open filament circuit,

- (o) DISREGARD STUDS VTC, VT-1, VTH, VTL, VTL-1, C-1, SWT, SWR, SWL, SWU AND SWC ON THE CONTROL WHEN CONNECTING THE EQUIPMENT. THEY ARE ALL DEAD TERMINALS AND ARE NOT REQUIRED ON THIS PARTICULAR UNIT.

15. CONTROL RECEPTACLES - Three female receptacles are provided on the lower side of the control board.

The upper, which will accept only the special lock-in plug furnished, provides a separate source of 115 volts AC for miscellaneous applications. The maximum capacity of this outlet is 10 amperes and the current supply will be cut off when the control is shut down. Giving the plug a quarter turn in a counter-clockwise direction will permit its removal from the receptacle.

The center receptacle provides a means for connecting a hand timer in place of the LF or Microtimer. However, terminals CB-1 and CB-3 must first be connected together.

The lower receptacle provides a means for connecting an additional footswitch for fluoroscopy.

16. HAND PUSH BUTTON - The hand push button, which is used on radiographic work only, should be pressed and held down to make an exposure. Upon completion of the exposure the button may be released. DO NOT PRESS THE BUTTON A SECOND TIME FOR THE SAME FILM OR AN OVER-EXPOSURE WILL RESULT.

During fluoroscopy the hand push button automatically becomes inoperable.

17. FILAMENT CURRENT LIMITING RESISTORS - Two adjustable filament current limiting resistors are provided at the rear of the control.

Their purpose is to minimize the possibility of applying excessive filament currents to the x-ray tube, either thru the carelessness of the operator, or when switching from the large to the small filament as is the case when changing focal spots.

The one on the left (as viewed from the rear) is the fluoroscopic resistor. It has one sliding adjustment which, when raised reduces the filament current, and when lowered increases it.

The one on the right (as viewed from the rear) is the radiographic resistor. It has two sliding adjustments, the upper one controlling the small focus filament and the lower one the large focus filament. Raising either of these adjustments reduces the filament current, lowering them increases it.

Both resistors have been carefully set at the factory and their adjustments should not be changed unless it is found impossible to reach the upper milliampere range of the equipment.

When such is the case, and all other possible causes for the condition, including the x-ray tube, have first been investigated, the filament current may be gradually increased until satisfactory operation is obtained.

After the adjustment is completed, make certain that the locking screw on the sliding collar is tightened sufficiently to assure good contact.

18. HIGH TENSION TRANSFORMER (See drawing 3-D-8939) - The No. 979966 oil insulated high-tension transformer furnishes both high potential and filament current for the x-ray tube. It should be permitted to stand in a warm room (70°F or higher) for at least six hours after shipment, with its breathing vent open, before operating, in order to allow air bubbles trapped in the oil to rise to the surface. The oil level, which should be checked before putting the unit into service, and every six months thereafter, must be maintained to within approximately 1/4 in. of the underside of the top panel. If it becomes necessary to add fresh oil use only the No. 2772 Wemco "C" transformer oil furnished with the equipment. Additional oil of this type is available in 1 qt., 1 gal., 30 gal., and 50 gal. containers.

NOTE: BE CAREFUL NOT TO CONTAMINATE THE INSULATING OIL WITH DIRTY HANDS, TOOLS, OR MOISTURE WHEN WORKING ON THE INTERIOR PORTIONS OF THE TRANSFORMER. FAILURE TO TAKE THIS PRECAUTION MAY RESULT IN SERIOUSLY IMPAIRING THE DIELECTRIC QUALITY OF THE OIL.

19. ASSEMBLY - Assemble the equipment carefully and in accordance with the step by step instructions which follow. If any step is not clear, refer to the paragraph dealing with the item in question under "General Description," before proceeding.

After placing the transformer and control in the desired positions, proceed as follows:

- (a) Remove the sheet metal housing from the control. Remove the decorative cover from the top of the transformer. Remove the breathing vent screw from the oil filler plug located on top of the transformer.
- (b) Mount the microtimer or L.F. timer on the rear of the control by means of the bracket and screws provided. If a hand timer is to be used instead, insert its plug into the center receptacle on the lower right side of the control. Then connect control terminals CB-1 and CB-3 together.
- (c) Connect terminals XFC, XFL, XFS, G, MA, A, and AA on the transformer to the correspondingly marked terminals on the control.

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- (d) Connect control terminals BC and BMC to the Bucky contacts in the x-ray table.

Connect control terminals BM and BMC to the Bucky release magnet in the x-ray table.

NOTE: The above four connections may be made with three conductors since BMC is common to both BC and BM.

- (e) Connect control terminals FS, FS to the foot-switch receptacle in the x-ray table.
- (f) Connect control terminals B, CB-1, CB-2 and CB-3 to correspondingly marked terminals in the microtimer. (If a L.F. synchronous timer is to be used in place of the microtimer, connect it to the B, CB-1, CB-2 and CB-3 control terminals as outlined in Par. 14-H on control terminal identification). If a hand timer is used disregard these terminals and proceed as outlined in Par. (b) above.
- (g) Connect control terminals CC, and C-2 to the correspondingly marked lugs of the hand push button.
- (h) Connect control terminals RL, RL to the fluoroscopic accommodation light circuit if such facilities have been provided.
- (i) Connect both shock-proof high-tension cables to the transformer and tubehead, being careful to insert the cathode and anode cables into their proper sockets. The former has three conductors and the latter one conductor.

In connecting the cables to their respective units, DO NOT PERMIT THEM TO DROP INTO THE HIGH-TENSION SOCKETS. Insert the end carefully, using the slot in the socket collar, and the pin on the cable fitting as guides. When it is certain that the cable has entered the socket fully, lock the assembly by screwing down the round cable nut.

- (j) Set the potential dials at 30 kv. Turn both filament regulators and all other controls in a counter-clockwise direction as far as they will go so that they are in their "minimum" positions.
- (k) Measure the incoming line voltage with a good AC voltmeter (0-300 volts) and set the line voltage selector strap on the control terminal panel to the stud corresponding closest to the indicated value. (See Par. 14-H on terminal identification).
- (l) Connect the incoming power line to studs L-1 and L-2 on the control. Connect the "G" terminal on the control to a good ground. (See page 2 for wire sizes).
- (m) Assuming all connections have been properly made, the equipment is now ready for operation.

After taking all the usual precautions against high-voltage, and exposure to x-rays, proceed as follows:

The paragraph references shown at the end of each of the following steps

refer to sections of the instructions in which the use and operation of the various components is explained.

20. FLUOROSCOPIC OPERATION

- (a) Set the "Fluoroscopy-Radiography" toggle switch to the fluoroscopic position. (Ref. Par. 12).
- (b) Set the two potential controls to the desired kilovoltage (ref. Par. 2).
- (c) Turn on the control Main Switch (ref. Par. 11).
- (d) Press the line voltmeter button (holding it down) and adjust the Line Voltage Regulator until the Line Voltmeter reads zero (0). Then release the button. (Refer Par. 3 and 6).
- (e) Refer to the preliminary calibration chart at the end of these instructions. (Ref. Par. 7).

Preset the Calibration Control (as indicated by the line voltmeter without the button depressed) to the value shown for the kilovoltage and milliamperage selected. (Ref. Par. 4).

Preset the (lower) fluoroscopic Filament Regulator (as indicated by the filament meter) to the value shown for the kilovoltage and milliamperage selected. (Ref. Par. 5 and 7).

NOTE: DO NOT EXCEED VALUES SHOWN ON TUBE RATING CHART FOR FLUOROSCOPIC OPERATION.

- (f) Step on the footswitch and observe the lower (0-10) scale of the milliammeter. If the milliammeter does not indicate the exact value selected, the filament regulator may be adjusted while x-rays are on until the desired reading is obtained. The filament meter reading for the indicated milliamperage should then be recorded on the Final Calibration chart for future reference. (Ref. Par. 5, 7, 8).

21. RADIOGRAPHIC OPERATION

- (a) Set the "Fluoroscopy-Radiography" toggle switch to the Radiographic position. (Ref. Par. 12).
- (b) Set the "Timer-Bucky" toggle switch to the position desired. (Ref. Par. 13).
- (c) Set the "Focus" toggle switch to either the "large" or "small" position. Since the focal spot to be used is determined by the milliamperage, kilovoltage, and time selected, the tube rating chart should be referred to before setting this switch. (Ref. Par. 11).
- (d) Set the two potential controls to the desired kilovoltage. (Ref. Par. 2).
- (e) Turn on the control main-switch. (Ref. Par. 1).
- (f) Press the line voltmeter button (holding it down) and adjust the line voltage regulator until the line voltmeter reads zero (0).

100 MA UNIT (W)

Then release the button. (Ref. Par. 3 and 6)

- (g) Refer to the preliminary calibration chart at the end of these instructions. (Ref. Par. 7)

Preset the calibration control (as indicated by the line voltmeter without the button depressed) to the value shown for the kilovoltage and milliamperage selected. (Ref. Par. 4)

Preset the (upper) Radiographic Filament Regulator (as indicated by the filament meter) to the value shown for the kilovoltage and milliamperage selected. (Ref. Par. 5 and 7)

- (h) Set the timer for the desired time.

Note: The maximum capacity of this generator on radiography is 100 Ma at 85 KVP and 10 Ma at 100 KVP. However, these values are subject to x-ray tube limitations, and the tube rating chart should therefore always be referred to before making settings.

Allow sufficient idle time between exposures to avoid overheating of the x-ray tube. See tube rating charts for additional information.

- (i) Press the hand push button and hold it down until the exposure is completed. The upper (0-100) scale of the milliammeter will indicate the milliamperage applied to the x-ray tube.
- (j) Turn off timer motor and control main-switch to shut equipment down after the exposure is completed.

22. OPERATING PRECAUTIONS

- (a) Always refer to the calibration chart before making current or voltage settings.
- (b) Always refer to the tube rating charts before making an exposure and never exceed the maximum values shown.
- (c) Do not keep the control main switch in the "ON" position needlessly when x-rays are not being generated. This avoids unnecessary burning of the x-ray tube filament and contributes greatly toward longer tube life.

CALIBRATION - Since a number of variable conditions, such as differences in power line and x-ray tube characteristics must be compensated for on each new installation, the calibration data obtained on factory tests are very likely to be found only approximately correct when the equipment is connected to another power source.

They are intended to serve only as a basis for preliminary operation, and a complete and final photographic calibration check should be made before attempting routine operation. An additional blank form is provided for this purpose.

Care should be exercised to avoid subjecting the x-ray tube to conditions in excess of its rating during calibration. (See tube rating chart before proceeding.)

100 MA UNIT (W)

MODEL OF
PRELIMINARY CALIBRATION

Transformer Style No. _____ Control Style No. _____

Transformer Serial No. _____ Control Serial No. _____

Adjust controls in the sequence numbered:

		1.	2.	3.
MA	KV	Line Voltage Regulator Preset	Calibration Control Preset	Filament Regulator Preset
5	60	0	0.5	320
10	60	0	0.8	330
20	60	0	1.2	360
30	60	0	1.2	375
50	60	0	2.4	410
60	60	0	3.5	460
100	60	0	5.4	520

100 MA UNIT (W)

FINAL CALIBRATION

Transformer Style No. _____ Control Style No. _____

Transformer Serial No. _____ Control Serial No. _____

Adjust controls in the sequence numbered.

1.

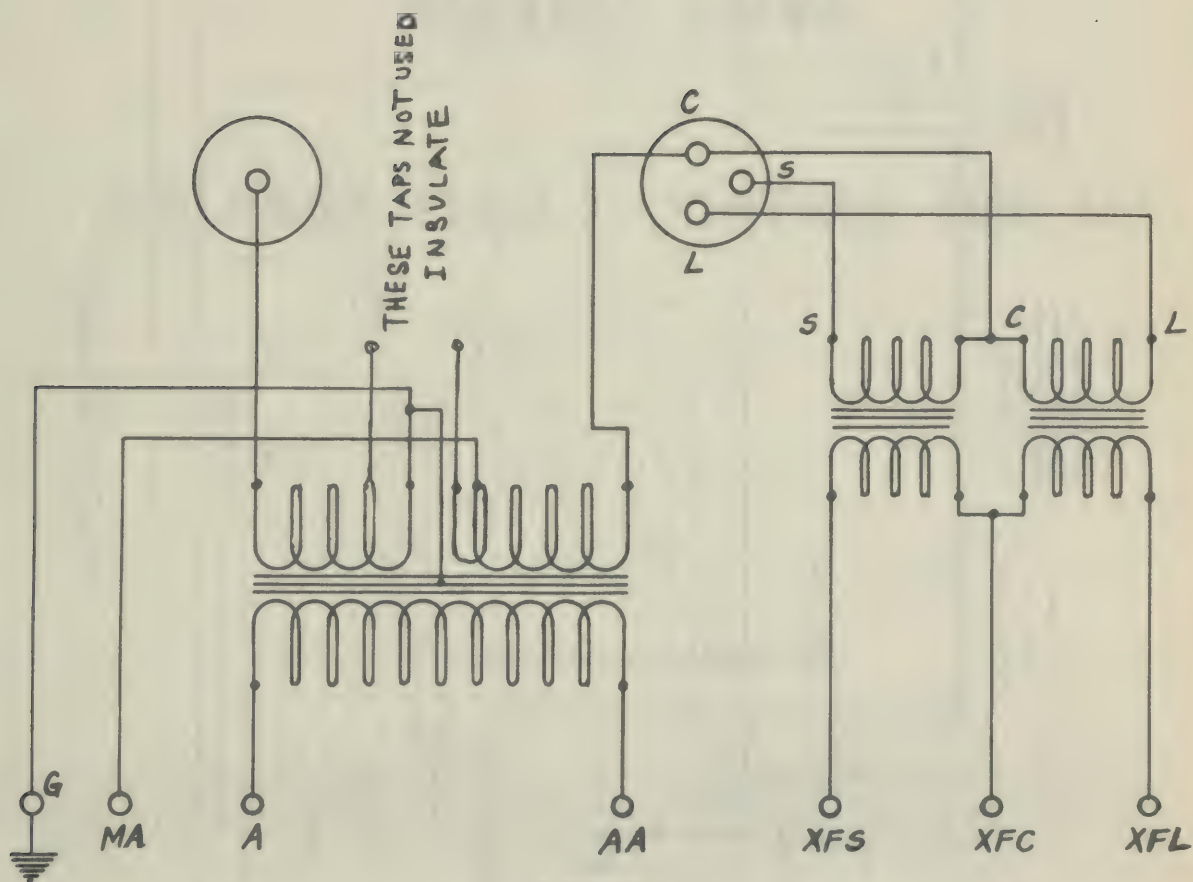
2.

3.

MA	KV	Line Voltage Regulator Preset	Calibration Control Preset	Filament Regulator Preset

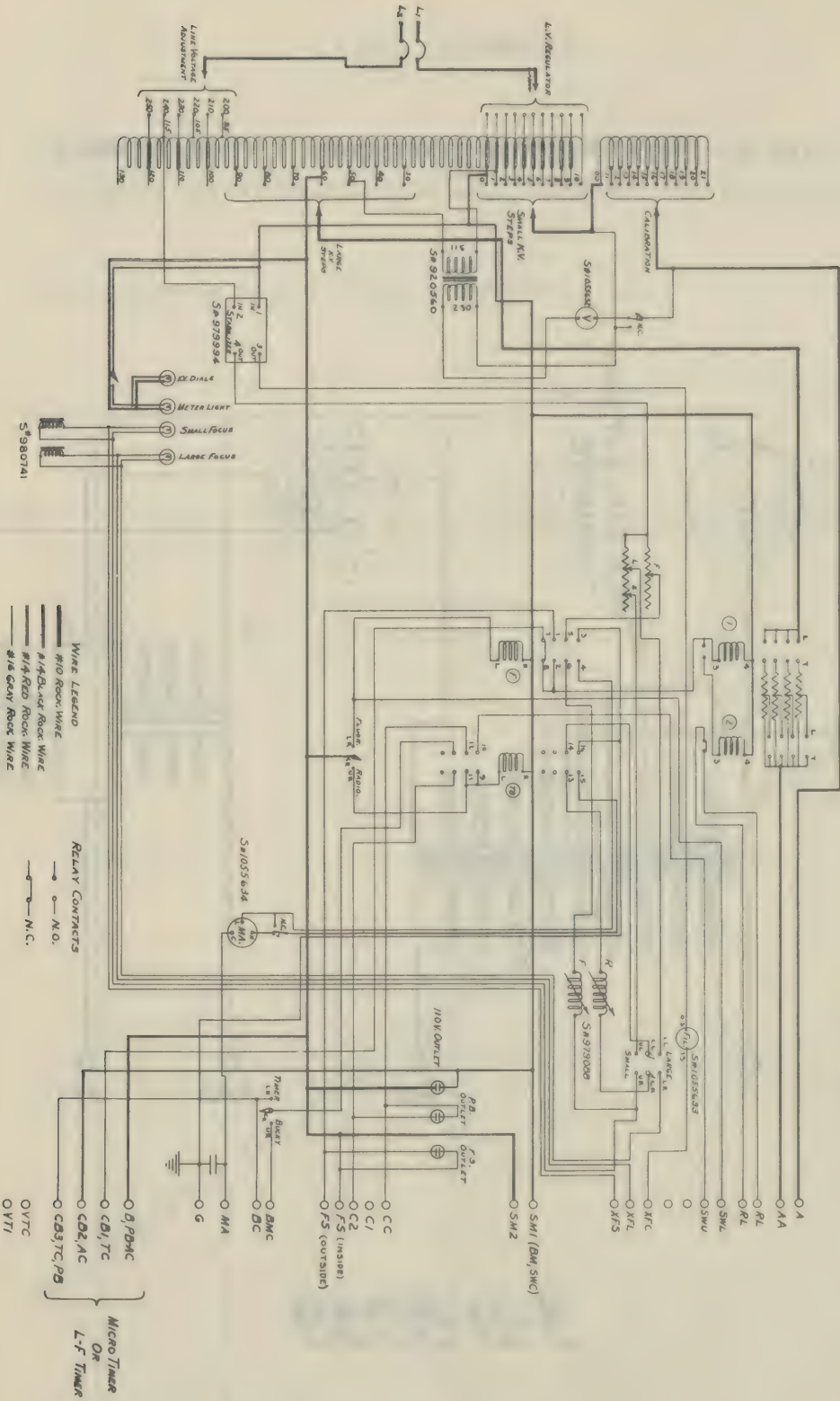
SERVICEMAN FILLS THIS OUT AND LEAVES IT WITH THE COMPLETED INSTALLATION

100 M.A. SELF RECTIFIED TRANSFORMER - WIRING DIAGRAM



3-D-8939

100 MA UNIT (W)



RADIOGRAPHIC PEDESTAL CONTROL
SCHEMATIC WIRING DIAGRAM OF 100 MA. CONTROL
2-B-8573

SECTION XLIII

KELEKET 115-A-1 CONTROL 200 MA

SECTION XIII

RELATIVE 115-A-1 CONTAINS 900 MW

INSTRUCTIONS

Description of Keleket 200 M.A. Multicron X-Ray Generator and Control.

RATED CAPACITY - This generator consists of a shockproof, four valve, full wave rectified, high-tension generator with a capacity of 115 K.V.P. at 10 M.A. and 100 K.V.P. at 200 M.A.; and is designed for operation on 220 volts, 60 cycles single phase, alternating current. It includes a Mobile Floor Control Unit, Shockproof Oil Immersed Generator, Interconnecting Cables from Control to Generator and a 20 foot length Inlet Cable.

HIGH-TENSION TRANSFORMER ASSEMBLY - The high-tension transformer, the valve and x-ray filament transformers, the valve tubes and the high-tension switch are completely immersed in oil in a grounded metal container. A breather plug is provided to take care of the thermal expansion of the oil. The plug must be loosened or backed off two or three turns to allow proper breathing for equalizing air pressure. The transformer assembly is built as an integral unit on a frame constructed of cold-rolled steel, with legs arranged to rest on the bottom of the tank. The assembly frame is also attached to a substantial top plate, and may, if necessary, be lifted from the tank as a unit.

The transformer assembly top plate carries the high-tension switch, four high-tension insulator sockets for the shockproof cable terminals and the low voltage terminals for connection of the control interconnecting cable. The top plate is approximately the length of the transformer tank but about 8" narrower so that when the transformer assembly is in the tank, there is a space of 4" between the top side edges of the tank and the edges of the top plate. These two openings permit access to the four valves and the high-tension switch without disturbing any of the circuits. A rectangular cover, with the center cut out, fits over and is bolted to the transformer tank and also to the top plate of the transformer assembly. This covers the rectangular openings at the sides of the top plate as well as stabilizing the position of the transformer assembly. A cork gasket is used to prevent any possible oil leak.

A false cover is provided for mounting over the high-tension switch motor drive mechanism, the low voltage terminals and the shockproof cable sockets. Bushings are provided in this cover for clamping the shockproof cable terminals in the sockets.

The high-tension transformer secondary is wound in two parts with provision for inserting milliammeter connections and maintaining the milliammeter at ground potential. The filament transformers are separately mounted on the transformer supporting frame and consist of two single valve filament transformers, one double valve filament transformer and two x-ray filament transformers for double focus tube. Ordinarily it is not necessary to lift the transformer assembly from the tank for changing valves or other service operations as the four inch space on either side of the top plate offers sufficient working space.

Two valve tubes are mounted longitudinally on each side of tank, supported by bakelite brackets having long leakage paths. On installation, the valves are inserted before filling the tank with oil, however, the valves are readily accessible near the top of the oil bath. When it is required to test, adjust or replace a valve, only a small quantity of oil need be removed in order to get at the valve in question. CARE SHOULD ALWAYS BE EXERCISED IN MOUNTING THE VALVES THAT THE MOUNTING CLIPS, ESPECIALLY ON THE CATHODE SIDE, MAKE POSITIVE CONTACT WITH THE VALVE TUBE TERMINAL POSTS. To facilitate inspection of the valves, so as to determine whether the filaments are lighted, a bull's eye lens is mounted in the top plate over each filament. A plug over each lens excludes the light from the valves except when inspecting them.

KELEKET 115-A-1 CONTROL 200 MA

The motor-driven high-tension switch, mounted on the top plate, is operated by remote control. It is a four pole, double throw type, switching the anode and three cathode leads. Also mounted on the transformer assembly top plate, are the four high-tension shockproof cable sockets, accommodating two anode cables and two (double focus type) cathode cables. When single focus tubes are used, the three conductor cathode cable with three prong transformer terminal is still used but in making up the cable, the terminal at the tube end has two of the circuits joined together as one and with the common at the second terminal form the double prong tube connection.

CONTROL UNIT

The control is of the mobile floor type occupying a floor space approximately 21" x 22". A cast iron base with four concealed swivel casters supports the control cabinet.

The meter panel has mounted in its upper left hand corner, a 7" double scale milliammeter with ranges 0-20 and 0-200 M.A.; and in the upper right hand corner a 7" pre-reading single scale kilovoltmeter with range 0-115 K.V.P. The two meters are indirectly illuminated by means of small lamps in the meter housings. Two smaller meters are mounted in the upper center between the Milliammeter and Kilovoltmeter, the uppermost being a Filament Ammeter with 1/20th ampere divisions; and the lower one being a Line Voltage Compensator Meter.

In the lower left hand corner is mounted flush with panel, the synchronous motor-driven timer with range 1/20 to 14 seconds. In lower center is the Ballistic Milliampere-Second Meter with range 0-50 M.A.S.; and in the lower right corner is a small switch panel containing four toggle switches. The right hand toggle switch selects the scale of the double scale milliammeter. The upper toggle places the Ballistic M.A.S. meter in the circuit. The left hand toggle controls the pilot and meter lights, while the lower toggle controls the "Bucky-Timer" interlock. One position of the switch is for *non-bucky* radiography, introducing the synchronous timer and the other side is for *bucky* radiography, the bucky exposure switch controlling the synchronous timer. An interlock exists between this switch and certain other control circuits so as to provide for flashing the valves when using 100 M.A. or higher.

The sloping switch panel has four main switch knobs, the one near the left rear corner is a ten-step line voltage compensator; lower left is the six position technique selector, providing fixed milliamperage settings of 5, 20, 30, 100, 150, and 200 M.A. This switch is four deck type, performing the following functions: the UPPER DECK is used to adjust the potentiometer circuit of the Pre-reading Kilovoltmeter so as to automatically adjust its readings for the different milliamperage loadings; the SECOND DECK selects the proper strap on the filament resistor and the proper lead on the filament adjustor transformer thus selecting the proper focus and setting the filament temperature; the THIRD DECK introduces the valve filament booster for the higher milliamperages; and the FOURTH or BOTTOM DECK introduces the "Foot Switch" and "X-ray" toggle into the circuit on the 5 MA setting. The two knobs on the right of the control switch panel control the auto-transformer major and minor switches, the one toward the rear being the major switch. These two switches are each ten-step switches and together provide 100 steps, the minor switch providing approximately 1 kilovolt steps.

In the lower center is the combination main line switch and overload relay which breaks both sides of the main line if for any reason the total current exceeds a safe value. The switch is controlled by a bakelite lever, while the overload relay is adjusted by means of a pointer knob immediately below the switch lever. The relay should be adjusted to release when slight over loading occurs for each multiple milliamperage setting, for safety purposes.

Near the center of the panel is mounted the knob controlling the resistance type filament regulator introduced when the Technique Selector is set at 5 MA. This regulator is not in the circuit on the higher current settings. At the top of the switch panel are three pilot lights indicating "Main" when main switch is on, "filament" when X-ray tube filament is energized and "X-ray" when the high-tension transformer is energized.

Directly below the pilot lights are four toggle switches. The one on the left operates the high-tension switch; the next toggle toward right introduces foot switch circuit; the next controls filament circuit and the one on the right energizes high-tension transformer when Technique Switch is at 5 MA setting for therapy purposes. On all settings for higher milliamperages the "x-ray" toggle is out of the circuit.

Incorporated in the control is the FILAMENT COMPENSATOR TRANSFORMER which consists of a small auxiliary transformer with its primary connected across ("X" prime and "Y" prime) the primary of high-tension transformer and with its secondary in series with the x-ray tube filament loads. A "bucking" voltage is thus supplied in the filament circuit, its value depending on the primary voltage supplied to the high-tension transformer. The fixed milliamperage Technique Selector Switch selects a separate tap on the compensator transformer for each M.A. being used, thus assuring precise compensation for variable kilovoltage regardless of the milliamperage load. For a given setting of the Technique Selector Switch, the kilovoltage may be raised or lowered as desired throughout the range of the unit, with the assurance that the tube milliamperage will not change.

The filament compensator transformer effectively prevents change of milliamperage with variation in kilovoltage, but does not eliminate changes in filament current due to fluctuations in line voltage. To supplement and complete the action of the compensator transformer, a special filament stabilizer is utilized in the control. This stabilizer utilizes a combination of transformers, chokes and condensers. No adjustments need ever be made, and the absence of moving parts assures silent instantaneous action.

As was mentioned above, one deck of the Technique Selector Switch is used to adjust the kilovoltmeter circuit to compensate for different milliamperage loadings so that proper readings will be obtained with a SINGLE METER SCALE. There exists an inherent voltage drop in any unit between "no-load" and "load", requiring a different "load-line" for each M.A. technique. The potentiometer has a special winding on the auto-transformer so that for each setting of the Technique Selector a voltage is applied to the Kilovolt Meter of proper value to COMPENSATE for the voltage drop and thus give correct pre-reading values on a single scale.

The Magnetic Switch is of the Air Insulated type and permits remote control of the primary voltage supplied to the high-tension transformer. The push-button, foot-switch or timer merely energizes small holding coils on the magnetic switches the voltage to the high-tension primary being supplied through the heavy contacts of the magnetic switch. The switch is composed of two heavy duty multiple pole magnetic contactors, and a low resistance heavy current resistor. One of the heavy duty contactors has four poles, three of which are strapped together. When the switch is energized this contactor immediately closes connecting the voltage on X-1 through the surge resistor to the terminal X (one side of high-tension transformer). The second contactor with three poles strapped together is used to short out the surge resistor. The holding coil of this contactor is energized through the extra set of contacts on the first contactor and thus this second contactor closes a very short time after the closing of the first contactor. Thus the resistor is in the circuit

for a very brief interval so as not to effect the exposure but long enough to effectively reduce any tendency toward production of primary voltage surge.

CARE AND SERVICING

In dusting the meters, sometimes a static charge is left on the glass cover over the meter scale, causing the indicator to be attracted away from the zero position. THIS WOULD LEAD TO A FALSE METER READING UNLESS THE STATIC CHARGE IS CAUSED TO LEAK OFF BY BREATHING ON THE GLASS.

The sides of the control cabinet are removable for service operations but fit sufficiently tight so that the interior is protected from dust. Should it become necessary to dust the interior of the control cabinet, an air blast should be used.

The switches and other moving parts in the control are self-lubricating. The motor-driven high-tension switch mounted on the transformer has packed motor bearings and require no lubrication.

Because of the necessarily complicated nature of the circuits, service operations should only be undertaken by a qualified service engineer.

(a). *Control Not Energized:* If prereading Kilovoltmeter or Line Compensator Meter does not read upon closing Control Main Switch, check to see if (1) Service Switch has been closed; (2) Service Fuses have been blown; (3) Control Fuses have been blown; (4) Power lines to Main Service Switch dead.

(b). *Filament Not Lighted:* Check Tube Selector Switch to determine if tube being observed is one selected; check cable terminals for poor contact; check fuses leading to stabilizer; check filament switch to see that it is thrown to ON position.

(c). *Push Button Does Not Energize Tube:* Bucky toggle switch turned to BUCKY-TIMER position and Bucky not cocked. Examine control fuses. X-ray filament not energized. Magnetic switch not energized.

(d). *Overload Relay Opens On Closing Pushbutton.* Relay adjustment set for too sensitive a position. Decrease sensitivity and see if relay remains closed. Examine x-ray tube to see if gassy.

OPERATION PROCEDURE RADIOGRAPHY

The Multicron Control incorporates certain devices which simplify the procedure of setting up the unit for Radiography. The three radiographic factors which involve adjustment of the control are: kilovoltage, milliamperage and exposure time. In the Multicron, these factors can be adjusted independently. When the kilovoltage across an x-ray tube is changed there is a change in the space charge in the tube and even though the filament temperature may remain constant, there will be a change in the milliamperage. The FILAMENT COMPENSATOR TRANSFORMER adjusts the x-ray tube filament temperature, as the kilovoltage is changed, so that the milliamperage remains fixed. This device, together with certain other control circuits, make possible *fixed milliamperage selection*.

A potentiometer in the kilovoltmeter circuit compensates for voltage drop in changing the milliamperage loading so that a *single* pre-reading kilovoltmeter scale gives a true indication of the kilovoltage for all milliamperages.

KELEKET 115-A-1 CONTROL 200 MA

The following steps will set up the machine for a given current, voltage and exposure time, for use in making a radiograph:

1. Close Main Service Switch supplying voltage to the control.
2. Close Control Combination Main Switch and Overload Relay, energizing control.
3. Adjust the Overload Relay sensitivity for the Milliamperage to be used.
4. Adjust Line Compensator Switch so that the Compensator Meter indicator is on the red line.
5. Adjust Technique Selector Switch to the milliamperage required, (20, 30, 100, 150, 200 M.A.). The 5 M.A. (adjustable) setting of Technique Selector Switch is for use in fluoroscopy and therapy. The Technique Selector Switch automatically accomplished all of the adjustments required to obtain exactly the milliamperage desired.
6. Adjust the Major and Minor Auto-transformer Switches until the Kilovoltmeter reads the desired kilovoltage. Note: The order of steps 5 and 6 must not be reversed, that is, the milliamperage must be selected before the kilovoltage. It should also be pointed out that there is no limiting stop on the minor auto-transformer switch at the highest or lowest setting, so that the switch may be rotated in either direction continuously. This feature is intended to save time in advancing one step beyond any point when the minor is set for its highest position. In this case it is only necessary to continue the clockwise rotation one more step on the minor bringing it to its lowest position and then advance the major switch one step. SINCE THE MINOR SWITCH MAY GO FROM ITS HIGHEST TO ITS LOWEST SETTING BY ADVANCING ONE STEP, CARE SHOULD ALWAYS BE EXERCISED TO READ THE KILOVOLT METER EACH TIME THE MAJOR OR MINOR SWITCHES HAVE BEEN MOVED so as to substantiate proper K.V.P. reading.
7. Check the toggle switches and pilot lights:
 - (a) Selection radiographic tube.
 - (b) Throw Foot Switch toggle to OFF position.
 - (c) Throw Filament Toggle to ON position. (Filament Pilot Light indicates when filaments are energized). Filament toggle should ordinarily always be left in the ON position.
 - (d) Throw X-Ray Toggle to OFF position. This toggle must be kept in OFF position except when doing therapy.
 - (e) Turn meter lights ON. Meter illumination and pilot lights should be energized for radiographic procedures and therapy but may be turned off for Fluoroscopy.
 - (f) Introduce Ballistic Milliampere-Second Meter especially for Chest Radiography also 100, 150 and 200 M.A. exposures where milliamperage is to be checked thru the division of M.A.S. by exposure time in seconds. For other techniques put Ballistic M.A.S. meter toggle in OFF position.
 - (g) Select proper scale on the double Scale Milliammeter.
 - (h) For non-bucky radiography, set toggle at "Timer Only" position; for bucky radiography, set toggle at "Bucky-Timer" position.
8. Making Exposure.
 - (a) Non-Bucky Radiography. (Timer Only)
Set the synchronous timer for proper time and depress exposure pushswitch, keeping it depressed during the exposure. If pressure on the push button is relieved before the end of the exposure time, the exposure will be terminated.
 - (b) Bucky Radiography. (Bucky-Timer)
The bucky circuit is interlocked with the timer circuit in such a way that the bucky exposure switch controls the synchronous timer.

Thus when using the bucky for radiography:

Set Timer for proper exposure time.

Set Bucky Timing Knob to a slightly *longer* time.

Cock Bucky.

Depress Exposure Push Switch and keep it depressed during exposure.

9. After completing the exposure, open the control Main Switch so as not to keep the x-ray and valve filaments burning longer than is absolutely necessary. The habit should be established of turning off the control main switch while positioning patient between successive exposures if this operation takes any considerable time to accomplish. It does however take about two minutes for the primary X-ray tube filament resistor to come to normal temperature for a stable M.A. operation.

OPERATION NOTE: It should be called to the operators attention THAT ON THE HIGHER TUBE LOADINGS, (100, 150 and 200 M.A.) a time delay relay is introduced into the filament circuit for momentarily raising the filament temperature of the valves so as to pass the higher current and then returning them to the standby temperature after the exposure is completed. The standby temperature is proper for currents up to 50 M.A. and the "Flashed" temperature, for currents up to 200 M.A. A time delay of one second is allowed for the filaments to reach thermal equilibrium at the higher temperatures before the relay makes the exposure.

The following description will make clearer the sequence of operations due to the introduction of the valve flasher into the circuit. The lower toggle switch on the meter housing panel, has two positions marked, "Timer Only" and "Bucky-Timer" This toggle switch is interlocked with the Technique Selector Switch so that a different set of operations result for the settings 20 and 30 M.A. than for the settings 100, 150 and 200 M.A. The M.A. setting of Technique Switch will be discussed separately.

TOGGLE AT "TIMER ONLY"; TECHNIQUE SELECTOR AT 20 OR 30 M.A.

1. Depressing Push Switch energizes Timer.
2. Timer energizes Magnetic Switch.

TOGGLE AT "TIMER ONLY"; TECHNIQUE SELECTOR AT 100, 150 OR 200 M.A.

1. Depressing Push Switch energizes:
 - (a) Relay raising valve filament temperature.
 - (b) After one second delay, relay energizes timer.
2. Timer energizes magnetic switch.

TOGGLE AT "BUCKY-TIMER"; TECHNIQUE SELECTOR AT 20 OR 30 M.A.

1. Depressing Push Switch trips Bucky.
2. After bucky grid is in motion, Bucky Exposure Switch energizes timer.
3. Timer energizes Magnetic Switch.

Note: Set Bucky Timer Knob slightly in advance of indicated exposure time.

TOGGLE AT "BUCKY-TIMER"; TECHNIQUE SELECTOR AT 100, 150 OR 200 M.A.

1. Depressing Push Switch energizes.
 - (a) Relay raising valve filament temperature.
 - (b) Time Delay relay.
2. Time delay relay trips Bucky after one second delay.
3. After Grid is in motion, Bucky Exposure Switch energizes timer.
4. Timer energizes Magnetic Switch.

Note: Set Bucky-Timer Knob slightly in advance of indicated exposure time.

FLUOROSCOPY - When the Technique Selector is set for 5 M.A. a vernier resistance filament regulator is introduced into the filament circuit for accurately adjusting to 5 M.A. and to make possible variation between limits (about 2 to 10 MA.). The "Foot Switch" toggle and the "X-ray" toggle are introduced into the

KELEKET 115-A-1 CONTROL 200 MA

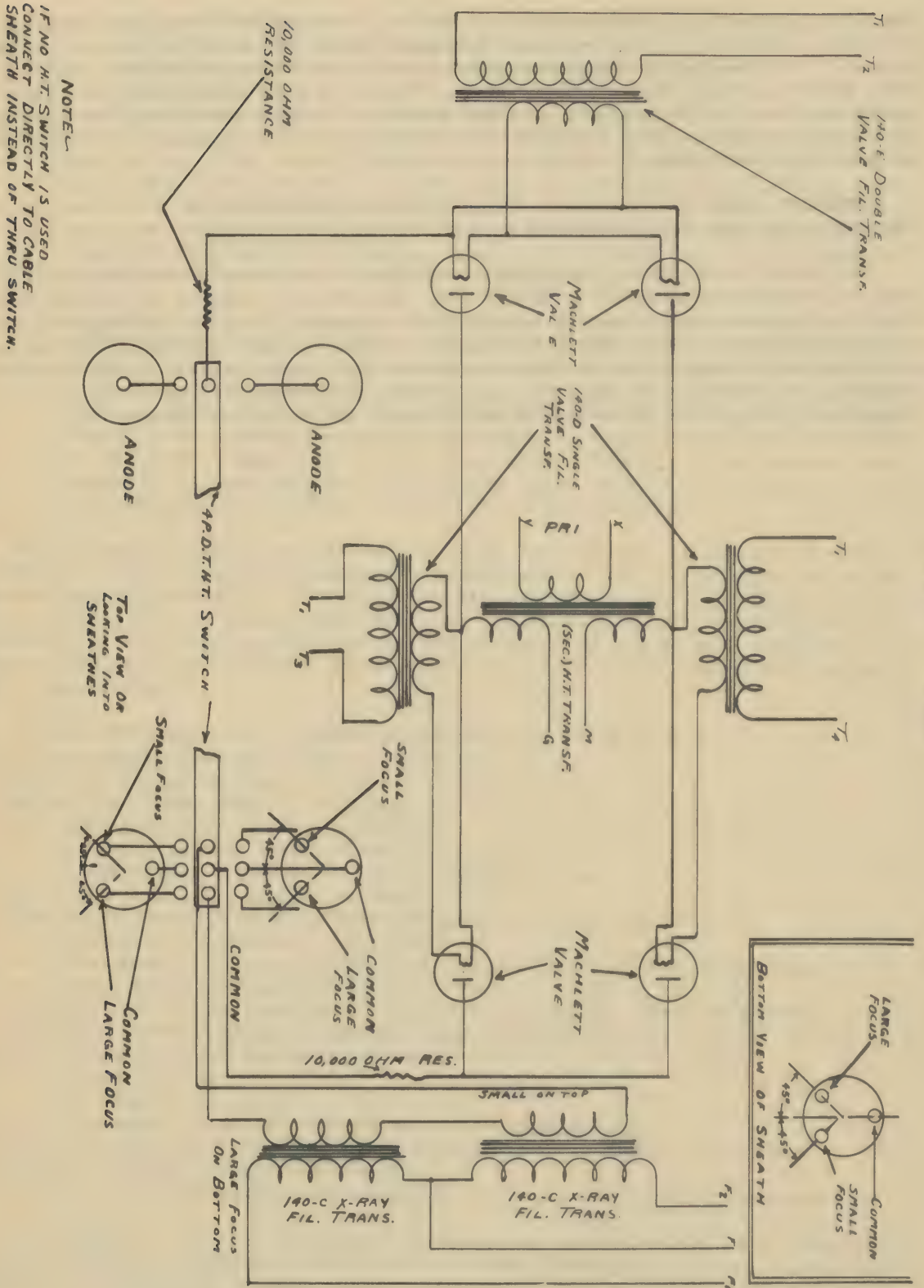
circuit only when the Technique Selector Switch is set to the 5 M.A. position, for all other positions of the Technique Selector, these two switches are not in the circuit. This feature prevents accidental exposure by means of the Foot Switch or X-ray Switch on the higher milliamperages. When doing Fluoroscopy, the foot switch toggle is thrown to ON position, in which position the foot switch is placed in the circuit and can be used to energize the transformer. A setting of 3 to 5 MA. is employed for fluoroscopy.

THERAPY - Turn the Technique Selector Switch to the 5 M.A. position. Check the toggle switches and place them in the following position:

Ballistic M.A.S. Meter toggle OFF; Light Switch ON; Bucky-Timer Toggle either position; Milliammeter Scale toggle to LOW; Tube Selector toggle to Therapy Tube (usually the radiographic tube is used also for therapy); Foot Switch toggle to OFF position; Filament toggle ON; X-ray toggle is used to make exposure, the timing of which can be made by an independent timer with range suitable for therapy technique or manually by consulting a clock. Cooling curve and heat storage capacity of tube should be consulted before using the tube for therapy.

KELEKET 115-A-1 CONTROL 200 MA

WIRING DIAGRAM



KELEKET 115-A-1 CONTROL 200 MA

WIRING DIAGRAM

F & F_s Small Focus
F & F_L Large Focus

Use-

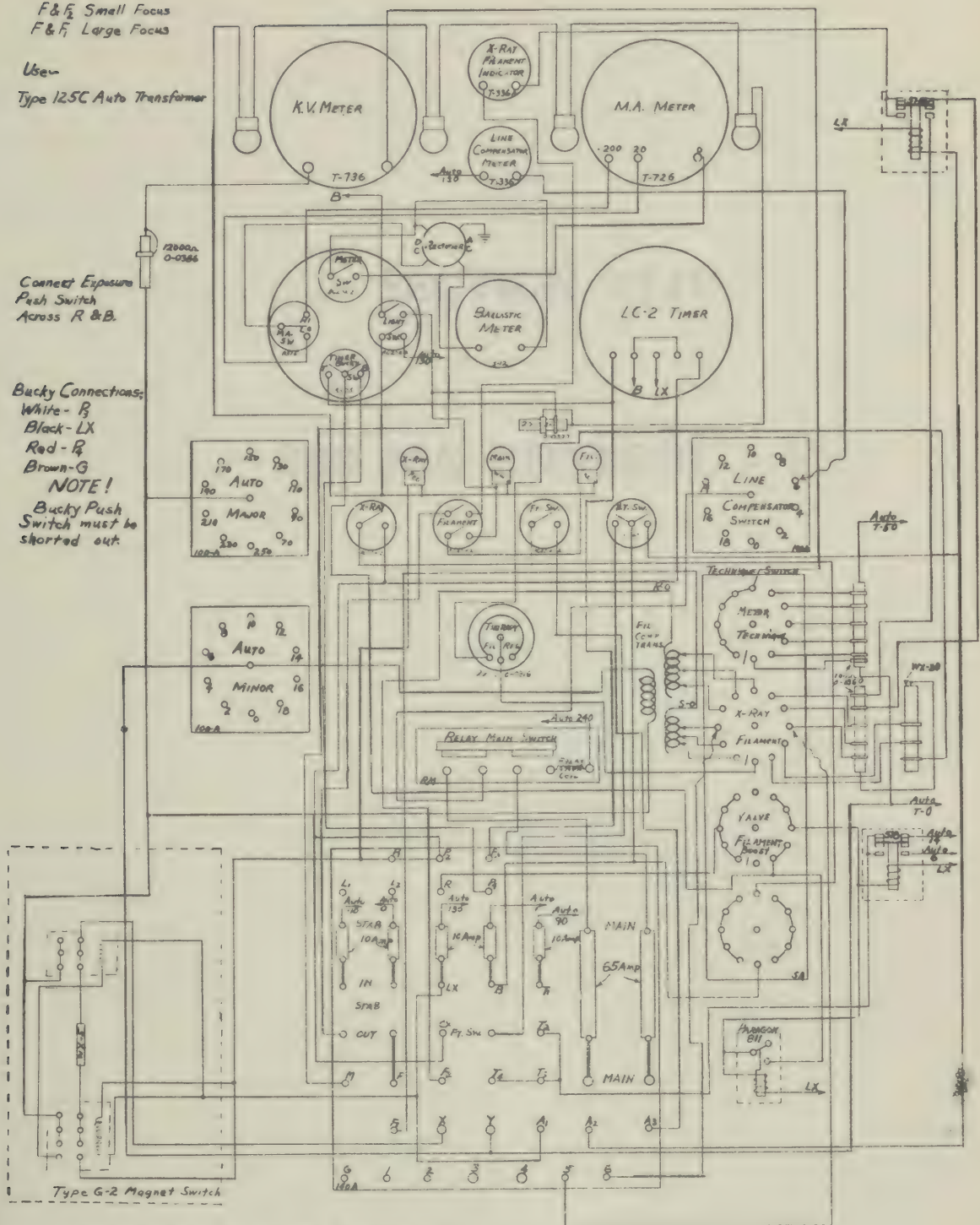
Type 125C Auto Transformer

Connect Exposure
Push Switch
Across R & B.

Bucky Connections:
White - B
Black - LX
Red - R
Brown - G

NOTE!

Bucky Push
Switch must be
shorted out.



Control adjusted for Spot Film Radiographs at
100 MA.

KV set for Spot Film work with Technique Switch
on 100 MA. Then Technique Switch is set on 5 MA
for Spot Film work.

Drawing # 74505

SECTION XLIV

200 MA CONTROL - P

200 MA CONTROL

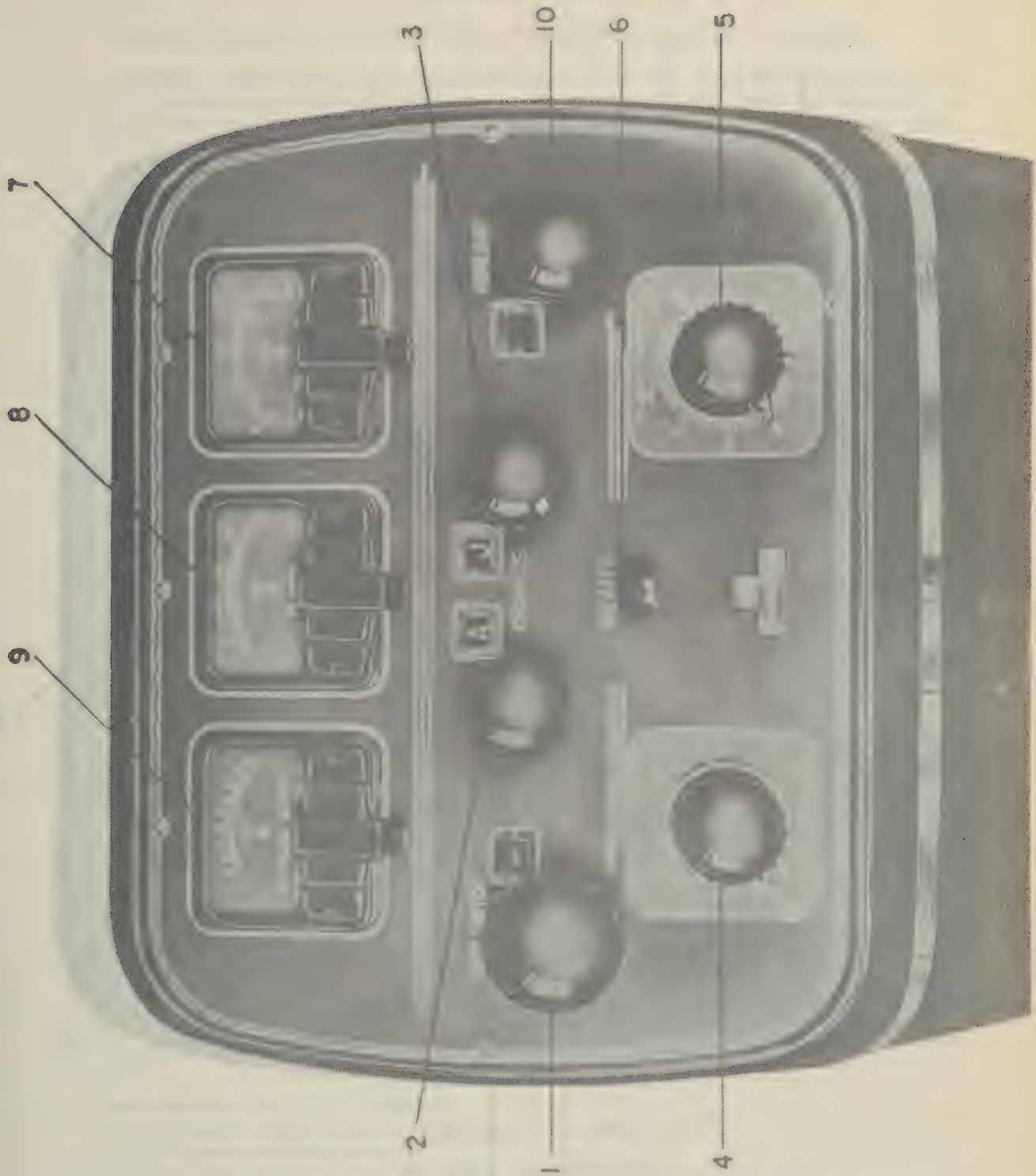


FIGURE A

200 MA CONTROL

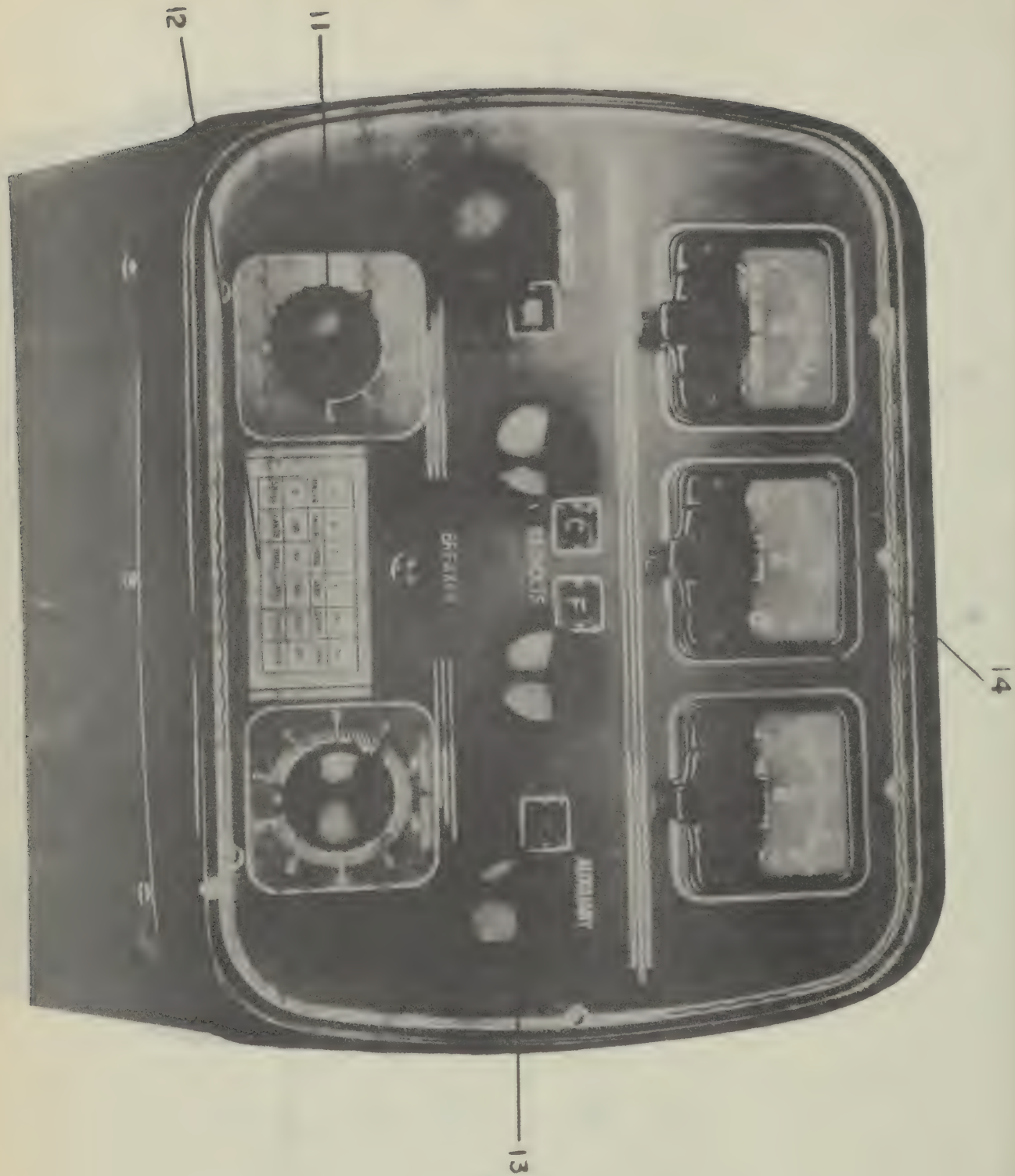


FIGURE B

200 MA CONTROL

INSTRUCTIONS FOR ASSEMBLY AND OPERATION OF WAITE "D" CONTROLS

GENERAL INSTRUCTIONS AND SUGGESTIONS - After the unit has been unpacked, a careful check should be made with the packing slip and the parts of the unit, to be absolutely certain that no parts have been left in any of the packing cases.

Every care is exercised in the packing of this equipment to insure safe arrival. All finished parts are protected with heavy wrapping of wax paper to prevent abrasion of painted surfaces.

If shortages occur they must be reported immediately. If the equipment shows any signs of external injury, the crates should be examined and the incident should be reported to the carrier, filing claim for the damage done.

This unit is available in several models, some of which are indicated in the illustrations. Most of this instruction applies in general to all models. Other sections are devoted to specific types. It is advisable to read carefully the general section and then locate the section applicable to the model at hand.

ATTACHING TRANSFORMER AND CONTROL CABLES AND GROUND WIRES - The control to transformer cable should be connected to the transformer and then to the control. The bucky cable should also be connected to the control stand. The line cable should be connected from the control to a suitable line switch which is properly fused. Care must be taken to be sure the line frequency and voltage corresponds to that stamped on the nameplate of the control and transformer. Otherwise, serious damage to the apparatus may be the result. If the bucky is to be operated on either "small focus" or "large focus" position of the main switch, connect its contacts to terminals 48 and 39. If it is desired to operate it on the "large focus" only, then connect it to 4 and 18. If the operation is desired on the "small focus" only, then connect it to 4 and 16. The coil of course is to be connected through the push button to 110 volt supply from the control. If the timer has time limit switches incorporated (monitor control) or if a dynamax tube is used, the bucky contacts should not be used and bucky coil is to be connected to studs B and 36 on the timer panel. This puts the bucky coil in parallel with the timer clutch relay coil, and this starts the bucky just ahead of the exposure, the timing being done by the timer.

The timer, cable, the push buttons, and foot switches may now be connected to the control. **DO NOT OPERATE THE UNIT UNTIL THOROUGHLY FAMILIAR WITH ITS OPERATION AS OUTLINED IN THE FOLLOWING PARAGRAPHS.** All separate pieces or units should be connected together and thoroughly grounded (preferably to a water pipe). The ground wire should be #12 wire equivalent or larger.

CONTROL - The type of control under consideration is known as "D" control of which there are several models available. The controls are shown in Figures A and B. To the standard control there can be supplied the following additional features:

- Motor drive high tension switch.
- R.F. changeover for operation with spot film device.
- Fluoroscopic limiting device.
- Monitor type control with or without R.F. changeover.

The control can also be supplied with special transformer and devices for higher milliamperages than the normal 200 M.A. rating.

Referring to Figure A, knob #1 is the main switch which may be thrown to either of two positions. This main switch will automatically change the focal spot size of

a double focus x-ray tube and at the same time will change the setting of the circuit breaker so that it will trip at a fluoroscopic setting on the small focus position, and will trip at a pre-determined radiographic setting on the larger focus. In addition to this, it automatically regulates the valve tube filament temperature. In order to prolong the valve tube filament life, the filaments are operated at lower temperature on fluoroscopy, or whenever the small focus of the x-ray tube is to be used. The main switch also automatically changes the milliammeter scale, which is normally a double scale meter with a low scale for fluoroscopy, and a high scale for radiography.

Knob #5 is a stepless induction type filament control, which has sufficient range for all types of radiography.

Knob #2 is the major kilovoltage selector. Knob #3 is the minor kilovoltage selector. These selectors have lettered indications starting with "A". On single valve, and self-rectified units the maximum P.Kv. is 99. On two-valve and four-valve units, the maximum P.Kv. is 109.

Knob #4 is a kilovoltage compensator for different milliamperages. Meter #7 is the milliammeter. Meter #9 is the voltmeter, and can be varied by means of a 10,000 ohms resistor in series with this K.V. meter. This, of course, corrects for differences in meters.

In order that the kilovoltmeter reads correctly for the different milliamperages, a bucking voltage is fed into the voltmeter circuit from an insulated winding on the autotransformer. Thus for a given primary voltage the P.Kv. indicated on the control voltmeter, will decrease as the kilovoltage compensator is raised from the 5 M.A. point to any selected tube current. In other words, if a given P.Kv. is to be maintained, a higher primary voltage must be selected as the kilovoltage compensator is adjusted for higher milliamperages. The nameplate beneath the compensator has, of course, a maximum setting of 200 M.A., the capacity of the #541 transformer.

The calibration of the unit is very carefully checked at the factory and there should be no need to change this calibration excepting under very different line conditions. Because the supply lines vary in capacity from one location to another, some adjustment must be provided to maintain the accuracy of the indicated P.Kv. at any milliamperage above the lowest. This extra voltage is a reserve voltage across a series resistor in the circuit of the insulated winding. For a poor line, part of this resistance is cut out thus increasing the back voltage in the kilovoltage compensating rheostat. This line voltage compensating resistor should be adjusted by measuring the P.Kv. with a sphere gap at 60 P.Kv. with a load of 200 M.A. To measure peak voltages at this load, an impulse timer and Ballistic meter must be utilized. The knob #4, the kilovoltage compensator for different milliamperages, should, of course, be set at the 200 point. When 60 P.Kv. is measured and 200 M.A. is indicated by the Ballistic meter, the line compensator is adjusted so that the indicated P.Kv. on the kilovolt meter is 60. If the indicated P.Kv. is correct at one selection, the kilovolt meter may be relied on for other settings.

The pre-reading x-ray filament meter #8 Figure A is used in conjunction with an amplifying circuit, the function of which is to amplify the movement of the primary x-ray filament meter for small corresponding differentials in the secondary filament circuit. This amplifying filament circuit includes a series limiting resistor, semi-variable to adjust for different types of tubes. The filament circuit is also provided with individual calibrating rheostats for large and small focus, or in the event that only one tube is used, for high and low range milliamperages.

200 MA CONTROL

The filament transformer is supplied through the usual filament control and the limiting resistor with two adjustable taps on the other side connected alternately in the circuit by way of one side of the double-pole, double-throw relay. Across the amount of limiting resistance placed in the circuit are the elements essential to the amplifying circuit. This consists of an inductance and condenser in parallel, both in series with the filament meter, and bridged by a small resistor. This unit circuit is also in series with two calibrating resistors alternately connected in the circuit in the same sequence as the corresponding limiting resistor.

It can thus be seen that the meter operates by virtue of the voltage developed across the limiting resistor and since the limiting resistance is in series with the filament circuit, the meter is really a primary filament ammeter. In addition to the limiting resistor furnishing the necessary voltage to energize the primary filament meter and its associating amplifying circuit, it acts as the name implies as a limiting resistor. It is possible, and usually desirable, to so set the value of the limiting resistor that when the filament control is rotated to its maximum position, the maximum milliamperage supplied by the apparatus is set at perhaps 15% or 20% higher than the rating of the machine. Thus on a Series 200 machine this could be set at 240 M.A. on large focus and 60 M.A. on small focus.

Then after the proper limiting resistance is found, a corresponding calibrator is rotated until about 90% deflection on the filament meter is secured. In rotating this knob, it will probably be noted that the meter will deflect rather slowly at first, but suddenly the amplification range will be reached and adjustment should be made as indicated above. With this adjustment made, the filament control should be retarded until amplification disappears which should be about 15% deflection on the meter, and if the top setting was 230 M.A., the lowest value will probably be in the order of 50 to 60 M.A. With this as the basis then, the main switch is changed over to small focus, the limiting resistance is set for a maximum value of perhaps 60 M.A., (making an overlap of 10 or 15 M.A.), the filament control set at the optimum position and the process repeated on the calibrator to effect amplification over this range of milliamperage. The change from one limiting resistance to the other and one calibrator to another is performed by the small relay whose circuit is actuated by voltage applied through the main switch. It is not recommended that adjustments be made on the resistor which is paralleled with the amplifying circuit since this has been set to the optimum position at the factory to insure maximum amplification. The only purpose of this resistance is to compensate for manufacturing discrepancies in inductance and capacitors.

For all fluoroscopic work the kilovoltage compensator is set at the minimum position which is marked 5 M.A. Accurate settings of Kv.P. may be obtained for all intermediate milliamperages by setting the kilovoltage compensator at the selected points between the major indications on the compensator.

For radiographic milliamperages, it may be desirable to calibrate this meter with the particular radiographic x-ray tube with which it will be used. This is best accomplished by calibrating the unit with a Ballistic or milliampere-seconds meter. If the Ballistic meter is an AC type it can be installed at the control by putting it in series with lead #5 from the transformer. If only a DC Ballistic meter is available, and if it is desired to check the kilovoltage, a set of calibrating adapters Cat. #1175 C & D which plug into the tube can be obtained from the factory for use with Px tubes.

If the tube under the table is to be calibrated, it may be easier to remove the table top and insert the Ballistic milliammeter between the anode reel and the anode of the x-ray tube.

200 MA CONTROL

The units have been calibrated at the factory with the length of cables with which the units will be used.

Knob #13 Figure B is a switch which controls a motor operated high tension switch in the high tension transformer. This then automatically changes from the x-ray tube under the table to the x-ray tube over the table, and a dial showing through the window beside the knob indicates "under the table", or "over the table".

Additional filament controls may be added. A second control can be added to the control top, if the transformer has a manual switch. A third filament control may be added, if desired, in a separate housing, which is made to mount on the side of the control stand.

RADIOGRAPHIC - FLUOROSCOPIC - CHANGEOVER DEVICE - Essentially this attachment serves to change over the machine from fluoroscopic settings to radiographic settings when the spot film device is tripped or shifted from the fluoroscopic to the radiographic position or vice versa. This apparatus serves as a means to quickly make these necessary adjustments on the apparatus compared to the lengthy procedure of making the changeover manually.

In changing from fluoroscopy to radiography the relays in the R-F changeover serve to change the filament setting by changing from one filament control to another, change the scale of the milliammeter, and change the operation of the footswitch from continuous exposure (as long as depressed) on fluoroscopy to timed exposure through the timer on radiography. When double focus tubes are used, the changeover will change focal spots simultaneously with the change of filament controls.

There is incorporated in the control a momentary contact toggle switch which can be used to check the radiographic setting without going over to the spot film device and tripping it.

In operating the unit the spot film device should be set in the fluoroscopic position, and the radiographic setting should be made on the control by depressing the momentary contact toggle switch. The switch is released and the fluoroscopic setting is then made. With the timer set for the desired exposure the exposures can be controlled from the table. With the spot film device in the fluoroscopic position depressing the footswitch will give a continuous fluoroscopic milliamperage. When the spot film device is tripped the footswitch will operate the timer for a radiographic exposure as previously set on the machine.

FLUOROSCOPIC LIMITING DEVICE - This device is added to some controls so that if one accidentally steps on the footswitch excessive milliamperage cannot be passed through the x-ray tube, even though the filament control is set to a high radiographic milliamperage.

This is controlled by knob #1 on Figure A which has two positions marked "Rad" and "Fluo". For all radiographic exposures this knob must be set on "Rad" while in order to obtain a fluoroscopic exposure through the footswitch it is necessary to set this knob on "Fluo", making sure in this case that the main switch is set on "Small Focus". If the main switch is set on "Large Focus" no exposure can be made through the footswitch.

BOOSTER - In all valve models of the control there is a valve tube filament booster. This is a special device which automatically boosts the valve tube filament temperature sufficiently to pass the milliamperage, which is flowing through

the x-ray and valve tubes at that instant. When the control is in a "stand by" position with the main switch turned on, but the exposure off, the valve tubes are burning at a normal temperature. When the exposure is turned on, the valve tube temperature is automatically boosted immediately, so that it will pass the desired milliamperage without damaging the valve tube. Immediately after the exposure is over, it automatically returns to its normal operating temperature. This can be easily checked by observing the valve tube meter during an exposure of over 70 M.A. It should visibly increase during exposure. The valves will visibly brighten if observed through an open valve tube cover plate.

There is also available for use with these controls a line voltage x-ray filament stabilizer. Space has been provided especially for this feature. The filament stabilizer maintains a constant voltage for the x-ray filament circuit regardless of changes in line voltages, or changes that would normally occur because of voltage drop in various parts of the control, such as the autotransformer, etc.

VALVE TUBE SETTINGS - On the main distribution panel or terminal board in the control, there is a valve tube filament primary ammeter. This has been calibrated at the factory with the valve tubes in the transformer.

It is very important that the limits specified on the valve tube primary filament ammeter must be held and should be checked carefully when the machine is installed. If the valve tube filaments are burned at too high a current, they will burn out prematurely, because of the excessive filament temperature. If the filaments are burned too low, they will not pass the desired milliamperage readily, and may become gassy or may even puncture.

The valve tube settings are calibrated in the following manner. A socket which has been arranged for a side parallel circuit is screwed on the bottom of a valve tube. This is then screwed into the valve tube socket in the high tension transformer. A 0-15 AC voltmeter is connected in the side of the special socket and reads of course the secondary voltage at the valve tube filament. The valve tube filament primary voltage is varied by adjusting the major and minor valve tube filament adjusting straps. The valve tube secondary filament voltage should be varied between 9.5 and 10.5 volts and a curve plotted between this secondary filament voltage and the reading of the primary ammeter in the control. The valve tube primary ammeter should then be specified between certain limits, namely, on the fluoroscopic setting from 9.5 to 10.0 secondary volts and on the radiographic setting 10.0 to 10.5 volts.

A complete wiring diagram is pasted on the inside of the control cabinet.

OPERATION OF THE UNIT - Before operating the unit, make sure that every cable connection has been carefully checked. It will be desirable to temporarily disconnect the x-ray tubes from the high tension circuit. This can be easily done by removing the ends of the x-ray tube cables from the shockproof transformer. It is also desirable to disconnect the high voltage transformer primary leads.

Make sure that the line voltage and frequency correspond to that stamped on the name plate of the control and transformer. Measure the line voltage with a suitable AC voltmeter and set the line voltage adjuster on the terminal board in the control to the tap that more nearly corresponds to the line voltage. For instance, if the line voltage is 213, set the adjuster on the 210 stud.

Set the valve adjusters on the terminal board of the control so that the valve tube filament meter will read between the specified limits.

When the control is first turned on, the major and minor voltage selectors should be turned as low as they will go. The filament control should be turned to its minimum setting. Check the voltage across the high tension primary terminals; it should be 0 until the exposure is turned on. Also check all auxiliary circuits such as the operation of the bucky, the radiographic fluoroscopic changeover, and if a rotating anode tube is used that the control circuits function satisfactorily paying particular attention to time delay circuit being in for the rotating anode tube and out when on the stationary anode tube. If everything appears normal, connect the x-ray tubes, one at a time, and with no high tension turned on, check the x-ray filament circuits through both the small focus and the large focus. See that the x-ray filament control raises and lowers the x-ray filament temperature on the x-ray tube. The operation of the changeover switch on the control can also be checked at this time. If the transformer has a motor operated changeover, this operation can also be checked at this time.

ROTALIX TUBES - There are a few x-ray tubes on the market, and in common use, with a higher than normal filament wattage. In order to use tubes of this type with these units, it will be necessary to parallel the 2 x-ray filament transformers in the high tension transformer tank. This is done by connecting terminals #6 and #10 on the high tension transformer together with a piece of wire or a metal jumper. The x-ray filament secondaries should be connected in series. This is done by connecting the filament circuit of the x-ray tube to the small inner spring and to the larger outer spring of the cable terminal, leaving the center conductor (which is the common lead) open. This must be done by a special connection on the Philips x-ray tube and should be ordered from their factory in this manner.

In addition to this it will also be necessary to have a special heavy duty filament control, which may be ordered from our factory. A resistor can be used to shunt the tube under the table so that the resistor and tube will draw enough current to read on the filament meter which has been adjusted for the higher filament currents of the tube over the table.

These units are normally for operation with double focus tubes, however, if a single focus tube is used under the table both the small focus and large focus leads (that is the "green" and "black" leads) from the cable should be joined together and connected to one side of the filament of the x-ray tube. The other side being connected to the common lead (namely the "red" lead). The tube will now light on both settings of the main switch.

However, if it is desired to use a single focus x-ray tube both under the table, and over the table, for both fluoroscopic and radiographic work, this can be accomplished by changing the x-ray filament primary circuit so that the same x-ray filament transformer will be energized no matter which way the main switch is thrown. This is accomplished by removing the lead from the control that normally connects to the #6 stud on the transformer, and connecting it together with lead #10 from the control to the #10 terminal on the transformer. This will then leave terminal #6 vacant, and there will now be two leads on terminal #10. If at any time a double focus x-ray tube is purchased, this lead may very easily be removed from #10 and replaced on terminal #6. The unit may then be operated with a double focus x-ray tube.

MONITOR TYPE "D" CONTROL - If the control is equipped with a monitor, the kilovoltage compensator knob #4 is replaced by a monitor switch desk equipped with six positions. This switch has five decks and one auxiliary toggle switch.

Kilovoltage compensator deck which controls the setting of the kilovolt meter

200 MA CONTROL

for the pre-determined or chosen milliamperages.

Calibrating rheostat deck which enables one to set the filament meter on the red line for that milliamperage which it is set on.

Limiting resistance deck which limits (by means of the tapped filament resistor) the milliamperage chosen to a safe maximum value.

Focal spot deck which picks up the desired focal spot on the x-ray tube.

Timer push-button selector deck which operates in conjunction with the timer safety attachment switches in order to limit the maximum exposure time for any given milliamperage.

In addition, the five deck switch has been supplemented by a cam and toggle switch, which serves to control the high voltage switch, picking out the correct positions, such as "over" or "under" the table position. The rest of the control is essentially the same as the conventional "D" control, without the monitor. As in the conventional "D" control, the main switch has the two positions, "small focus" and "large focus", and likewise selects the correct valve tube filament settings, the correct circuit breaker adjustment, selects the correct milliammeter scale and brings the foot-switch into the circuit for small focus. In place of the Picker emblem just below the circuit breaker knob #6, a small cardholder is placed containing the legend of the monitor settings.

OPERATION OF CONTROL - In operating the control, the main switch must be set on the correct focus corresponding to the one specified by the monitor chart for that position on which the monitor switch #11 Figure B is set. If this is not done, it will be impossible to make an exposure due to the safety interlock between the monitor and main switches.

The selector switches #2 and #3 Figure A are next rotated so as to obtain the desired kilovoltage as read by the kilovoltmeter.

The filament meter has a red line on it and it is to this red line that the needle must be set by means of the filament control so as to obtain the predesired milliamperage. If a radiographic exposure was picked out, then the timer must be set and the timer push button will give one the exposure; however, if it was a fluoroscopic setting, then depressing the footswitch will give one the exposure.

ADJUSTMENTS-KILOVOLTAGE CIRCUIT - The direct reading kilovolt meter is connected through a special compensating circuit consisting of one major adjustable resistor (1250 ohms) and a minor resistor (300 ohms) with adjustable taps at six points which feed deck #1 of the monitor switch. The kilovolt meter also has a 10,000 ohm adjustable resistor in series with one of its terminals. The resistor sets the kilovolt meter at no load, and thus takes care of the individual characteristics of the meters.

The control, before leaving the factory, undergoes a series of extremely rigorous tests, and the calibrations are accurately determined. However, due to possible extremely different line conditions and installation of the unit, it may be necessary to change the kilovoltage settings. If it is due to poorer line conditions, then all the settings will be off approximately the same amount, so by adjusting the strap on the 1250 ohm resistor more feed-back voltage can be applied (by decreasing the value of this resistance) to the kilovolt meter so as to decrease its reading, thus causing the kilovoltage selector knobs to be raised so as to

obtain the original reading on the kilovolt meter. Increasing the value of this 1250 ohm resistor effectively lowers the kilovoltage output of the unit.

If only a few of the kilovolt settings are off due to installation problems such as increased cable capacity, then these settings should be changed by moving the corresponding tap on the 300 ohm resistor. All settings, if made at 60 KV., will be found to hold correct through the kilovoltage range used.

X-RAY FILAMENT CIRCUIT - The x-ray filament circuit is made up of several different units. The filament meter #1 Figure B is connected to an amplifying circuit shown on the wiring diagram. This amplifying circuit is a resonant circuit consisting of an inductance and condenser, as in the standard control, the meter, however, has only a single red line to which the needle must be set.

In addition to this amplifying circuit, there is a milliamperage limiting resistor. This resistor has six adjustable resistance points, which correspond to each of the six tube monitor settings. These adjusters are set so as to limit the maximum milliamperage available to approximately 15% over the milliamperage indicated on the tube monitor. The reason for this is to prevent damaging the x-ray filament meter in case the filament control is accidentally turned all the way out. This, of course, safeguards the x-ray tube and the entire system. In order to set this resistor properly, the x-ray filament regulator should be turned practically all the way out and the resistor adjusted at each tube monitor setting until the filament is just barely in excess of the correct setting for the necessary M.A. at say 40 Kv. These resistors are all set at the factory and it should not be necessary to change these in the field unless a different type of x-ray tube is used.

After these limiting adjusters have been properly set, the next step is to set the exact milliamperage to correspond with the tube monitor settings. This adjustment is made by the six adjustable rheostats shown on the wiring diagram. These are numbered on the diagram to correspond with the tube monitor settings. In adjusting these rheostats so as to set the filament meter on the red line, it will be necessary to be careful not to overheat or overload the x-ray tube being used, because of repeated exposures. It is recommended that the kilovoltage used for calibrating these milliamperage settings should be in the neighborhood of 60 P.Kv., or the kilovoltage which will be most commonly used.

There will be found a 300 ohm adjustable resistor which shunts the filament meter. This resistor governs the sensitivity of the circuit and need not be changed.

It is a known fact that less filament heat is required to obtain a definite milliamperage as the kilovoltage is increased. In order to take care of this factor, a small amount of voltage is applied to the filament circuit through the calibrating resistors from a 25 ohm resistor across a small transformer. This resistor has 2 or 3 taps and these taps are connected to the various calibrating rheostats. The calibrating rheostats should be connected together in groups requiring the same filament compensation.

An individual setting is not needed for all settings of the monitor and similar milliamperage settings are grouped together. In order to check whether this is working correctly, the filament meter should increase slightly when the kilovolt selector knobs are increased, thus it is necessary to lower the filament as the kilovoltage is increased. It will be noticed that more compensation is needed for the higher milliamperage settings. By sliding the taps on the 25 ohm resistor, the amount of compensation can be varied to suit the individual tubes and settings used.

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SPOT FILM - If a spot film device is incorporated, setting #1 of the monitor will be both the fluoroscopic setting and the radiographic setting under the table. Thus when the monitor is set on position #1 and the spot film lever is on radiography, then the tube under the table can be set for a radiographic exposure which is made in this case through the timer by means of the footswitch. However, if the spot film lever is set on fluoroscopy, the tube under the table can be set for fluoroscopy by the additional filament control #10 Figure A, and the exposure is made directly by the footswitch. The footswitch is disconnected in the "over the table" position by means of a safety switch on the transformer. If a double focus tube is used under the table, the focal spot changeover from radiography to fluoroscopy is automatically taken care of. One must check before operating that the correct focal spots are operated at the correct time as it is quite possible in installation to get these reversed. This can, of course, be checked without applying high tension, disconnecting the high tension primary.

The timer push-button deck is so connected with the timer safety attachment switches that a certain group of milliamperages has a maximum exposure time limited by a switch adjusted inside the timer. The intermediate timer normally has three switches -- one operating in conjunction with the scale changing switch and two switches which are adjustable in relation to the timer adjusting dial gear. Normally, these switches operate in conjunction with the low range of the timer.

For purposes of explanation, let us assume that the monitor indicates a setting of 100 M.A. under the table and respective settings of 40 M.A. and 150 M.A. over the table. Also, let us assume at the probable maximum kilovoltage for the tube under the table at 100 M.A., the maximum time as given by exposure chart is 1 second, for the tube over the table at 40 M.A. that the maximum time is 30 seconds, and for 150 M.A. let us assume 2 seconds. In this instance, the scale changing cutout switch would be so wired as to allow operation on the long range only at 40 M.A. settings. On the other two settings, when the timer is thrown to long range, the push-button circuit is automatically opened. If the timer is thrown to the short range, operation will be allowable on the 100 M.A. setting up to 1 second. If the timer is set beyond this value, it automatically trips the small toggle switch and holds the push-button circuit open. Likewise, if we set the monitor to 150 M.A. over the table and attempt to set the timer dial beyond 2 seconds, the push-button circuit likewise will be automatically opened. In adjusting these two switches, it will probably be noticed that the switches are mounted on small brackets which in turn are mounted concentric with the shaft of the timer adjusting dial. Switches are locked simultaneously by means of the hex nut and lock washer. By backing off this nut slightly, both switches are free to move and can be adjusted practically within the full arc of the timer adjusting dial. By the installation of extra relays it is possible to obtain time limits on both the long and short range of the timer.

TRANSFORMER - The transformer is a 4-valve rectified unit and can be obtained as single or double focus, and with one or two-way outlets (either manual or motor drive.) The maximum milliamperage is 200 M.A. at 90 Kv. and maximum Kv. is 109 at 10 M.A. Upon unpacking and placing in position, the vent screw should be removed from the valve tube cover to equalize the pressure.

The transformer uses type ML-3 valve tubes and should one at any time fail, the transformer may be operated at a 2-valve (half-wave) transformer, by using 2 valves in the opposite corners. Note, however, the capacity of unit is now only 100 M.A. and the tube ratings are correspondingly lower for half-wave rectification.

The transformer incorporates what is termed a "safety switch". This is a blade type switch which is actuated by a cam on the high tension switch drive shaft. It

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is a normally open switch and is closed by the cam when the transformer is in "under table" position. This switch is to be wired in series with the footswitch so as to have the footswitch in the circuit only when in under table position. This, of course, does not apply to transformers having only one position.

This safety switch can also be used in conjunction with a rotating anode tube over the table, and a stationary tube under the table so as to cut out the time delay mechanism for the stationary anode tube.

300 M.A. UNIT - The normal capacity of the "D" control is 200 M.A. and 109 Kv. However, it can be obtained in a 300 M.A. and 135 Kv. capacity. It can be obtained with or without monitor and in this set up with up to a three way transformer. The transformer in this combination is either a #507 shockproof or non-shockproof, double or single focus and with one outlet only. When a two or three-way (shock-proof only) outlet is desired, this is a #549 type transformer, and is equipped with a manual motor drive switch. These transformers use ML-1 valve tubes instead of ML-3 as with the 200 M.A. unit.

The 200 M.A. control uses an oil immersed contactor (type 10126) mounted in the bottom of the control, which is satisfactory for up to and including 200 M.A. operation. For 300 M.A. operation it is necessary to use an external contactor which mounts on the side of the transformer, and is enclosed in a housing. This is type 1012 and is a single contactor. This contactor is sometimes used on the 200 M.A. units where the machine is subjected to extremely heavy duty.

It is also possible to use both impulse or combination timers with the necessary double contactors with both the 200 and 300 M.A. units. The terminal board of the controls incorporate studs for their connection as well as a pre-boost winding on the booster which is actuated when the impulse timer is used. This pre-boost results in better operation at 300 M.A., since it raises the valves to a temperature for 300 M.A. operation before the exposure is made.

With every unit equipped with impulse or combination timer a separate instruction manual accompanies the timer, which gives detailed instructions regarding the timer and contactors.

• **POSSIBLE OPERATING DIFFICULTIES** - If the voltmeter does not indicate, make sure:

1. That the line cable is properly connected to the receptacle of the supply line.
2. That there is voltage at this source of supply.
3. That there are no blown fuses.
4. That there is no break in the conductors within the line cable. This is most apt to occur at or near the point of connection of the cables to the transformer or control.
5. That a voltage selector switch or the line voltage compensator is not set on a dead button.
6. That there are no loose connections at the distribution panel within the control.
7. That the main switch is turned on.
8. That there is no open in the resistor associated with the voltmeter and its feed back circuit.

If the milliammeter does not indicate:

1. Make sure that the x-ray tube filament lights up.
2. Examine the connections of the control cable at the transformer. Be sure

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that it is properly connected and that no wires are broken off. This can usually be determined by slightly flexing the cable near the end with the idea that if a wire is broken, its ends may be brought in contact by flexation, lighting the filament temporarily.

3. Make sure that the timer or footswitch is properly connected and that good contact is established at this point. Further, that there is no failure in the timer or footswitch which usually can be determined by substituting one for the other.
4. That the circuit breaker knob is pushed all the way down.

Milliammeter indicates, but fluctuates:

1. Slight fluctuation may be expected because of line voltage changes. This can usually be traced to line voltage by watching the voltmeter and the milliammeter at the same time. If both show a change but if the change is greater at the milliammeter than at the voltmeter, it generally indicates fluctuation in line voltage. It may also indicate loose connections within the unit or in the supply line, but in most cases at the connecting lugs of the line cord.
2. If the milliammeter fluctuates severely and the voltmeter is quite steady, it may indicate a loose connection in the filament circuit of the x-ray tube, possibly at the point of contact between the tube holder and its cable. The x-ray tube will have to be removed to correct this. It is not likely to occur and all other conditions should be checked first.
3. Severe fluctuation of milliamperage may indicate a gassy x-ray tube. If all other points have been checked and the tube is removed, if it shows melting of the copper anode, it is safe to assume that the tube is gassy and was overheated through prolonged exposure.
4. If the milliammeter moves a division or so and then vibrates severely it indicates that the x-ray tube is bad.
5. Check the shockproof cable connections at both ends.

If the circuit breaker kicks out constantly:

1. This may be caused by too sensitive adjustment and it may be corrected by lowering the plunger within the circuit breaker by means of the adjusting screw and lock nut found at the bottom of the circuit breaker.
2. It may be caused by a defective x-ray tube. In this event it will usually be noticed that the pointer of the milliammeter has a tendency to fly across the scale and then back to zero as the breaker opens the circuit.
3. It may indicate a short circuit within the control or within the connecting cable between the control and transformer. This would be most apt to happen at the connections between the cable and the transformer.
4. It may indicate a breakdown of insulation, coils, etc., within the transformer. Under such a condition, the transformer should be returned for repairs. Under the very best conditions, where service is available, the cover might be removed and the transformer assembly withdrawn from the tank. However, this should never be attempted unless experienced help and the best of facilities are available.
5. It may be caused by a defective or punctured high tension cable. This can be checked by first disconnecting one cable, then the other, to determine which cable is causing trouble.

THERAPY KEY SWITCH - There are provisions to mount a key type lock switch for therapy use on the top of the "D" control. The wording "EXP.", "ON", "OFF" are engraved on the panel and mounting holes are provided for the mounting of this switch when desired. This wording and mounting holes are now covered with the Picker-Waite emblem on the lower center of the top panel. This switch should be

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wired to terminals 4 and 16 so that the operation of the key switch will turn the exposure on when the main switch is on the "small focus" position. Where it is not desirable to remove this emblem or where the space is used by a monitor setting, a switch with small housing which will mount on the side of the control can be obtained.

ELECTRICAL TESTS

Installation of "D" Control - 200 M.A. Unit

I. Set up equipment.

A. Control

1. 60 cycle A.C. line
2. Fuse at switch box 100 A.
3. 220 volt line. Line strap on proper tap. (use voltmeter)
4. All control knobs at lowest value.

B. Transformer

1. All valves out.

C. X-Ray Tube

1. Both cables out.

II. Make exposure (footswitch and hand timer) to determine that auxiliary circuits are O.K.

III. Test Valve Tube Voltage Settings

1. Put 3 valves in (M.L. #3).
2. Insert valve test connection in empty valve seat. (metal pipe, screw socket end, side parallel circuit)
3. Circuit Breaker "OUT", Main Switch "ON".
4. Determine voltage across test connection in valve seat. Use a 0-15 calibrated voltmeter. Correct settings are given in the instruction manual.
On PX test unit - (St. Louis Depot)
Large Focus - Maximum 10.5
Small Focus - Minimum 9.5
Latitude .5
5. If voltage incorrect, adjust valve voltage strap in control.

IV. Measure x-ray tube filament voltage at the cathode terminal (tube end) 12 to 18 volts.

V. Insert cables in tube.

1. Check filament energized.
 - a. Must correspond to focal spot selected by main switch at control.

VI. Hook up sphere gap, resistors (100,000 ohms each) by means of adapters, if available.

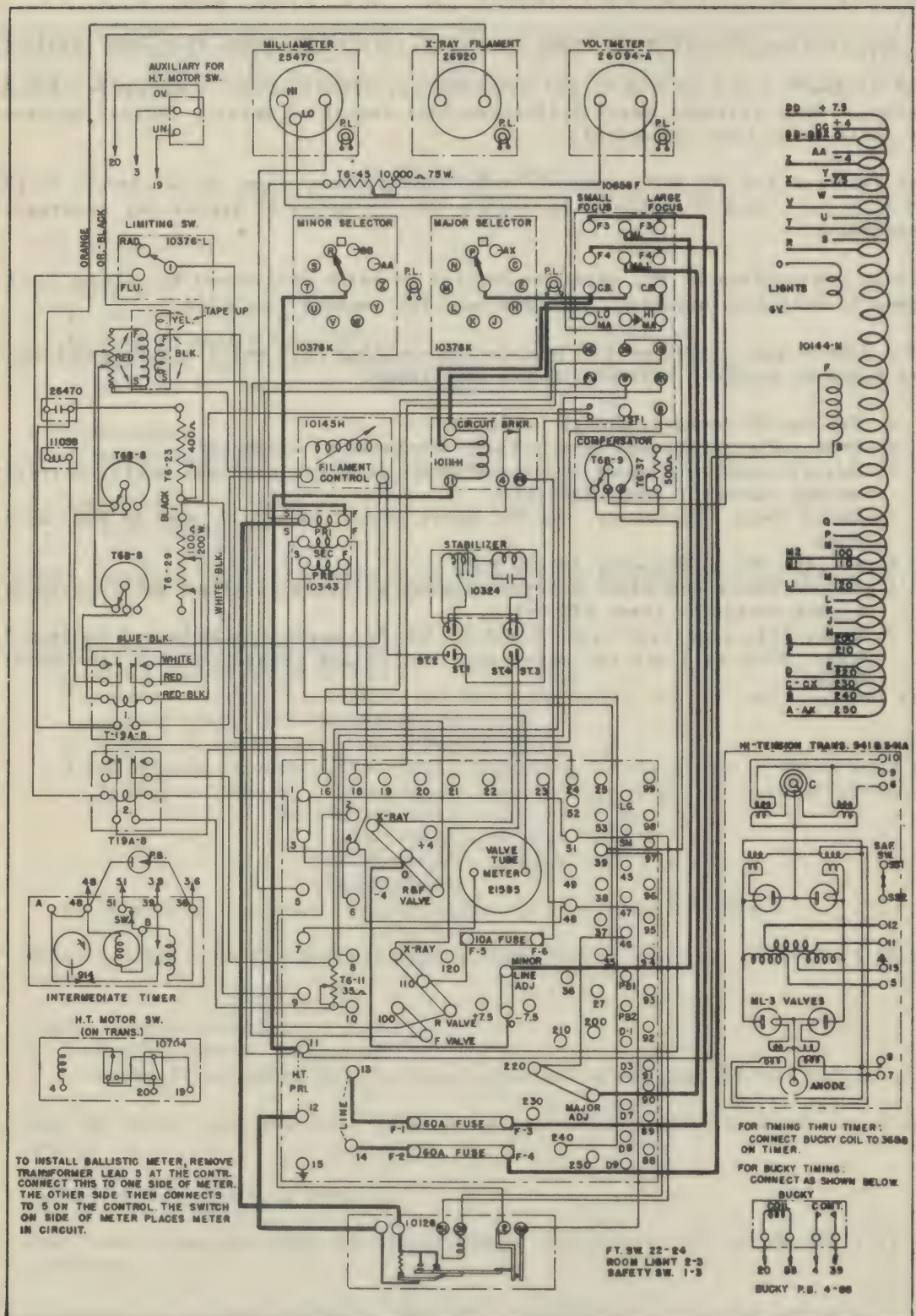
VII. Install M.A.S. meter in control.

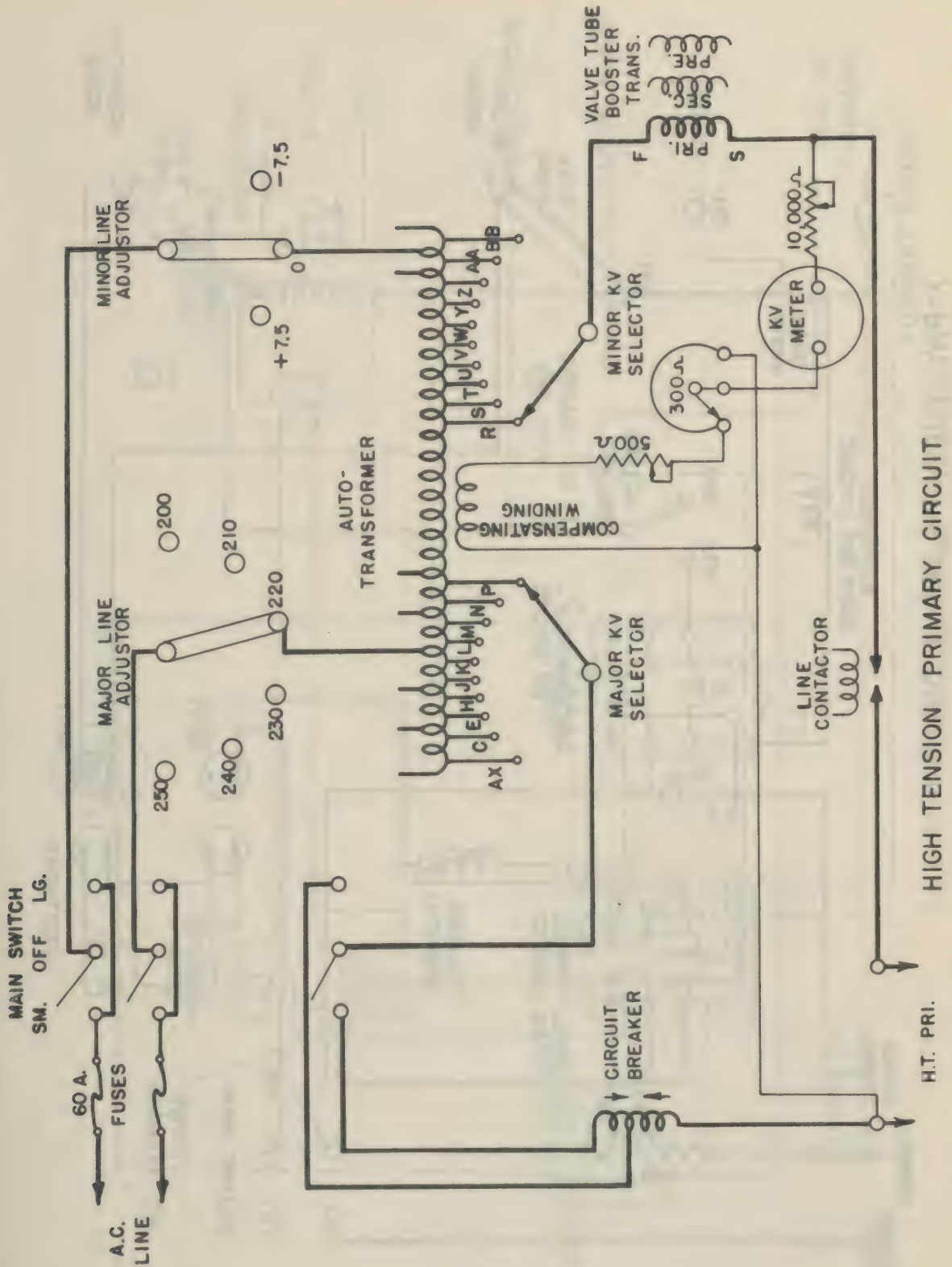
VIII. Test timer using spinning top using film in cassette. (100 MA, 60 KV, 1/10 sec., 30" Dist.)

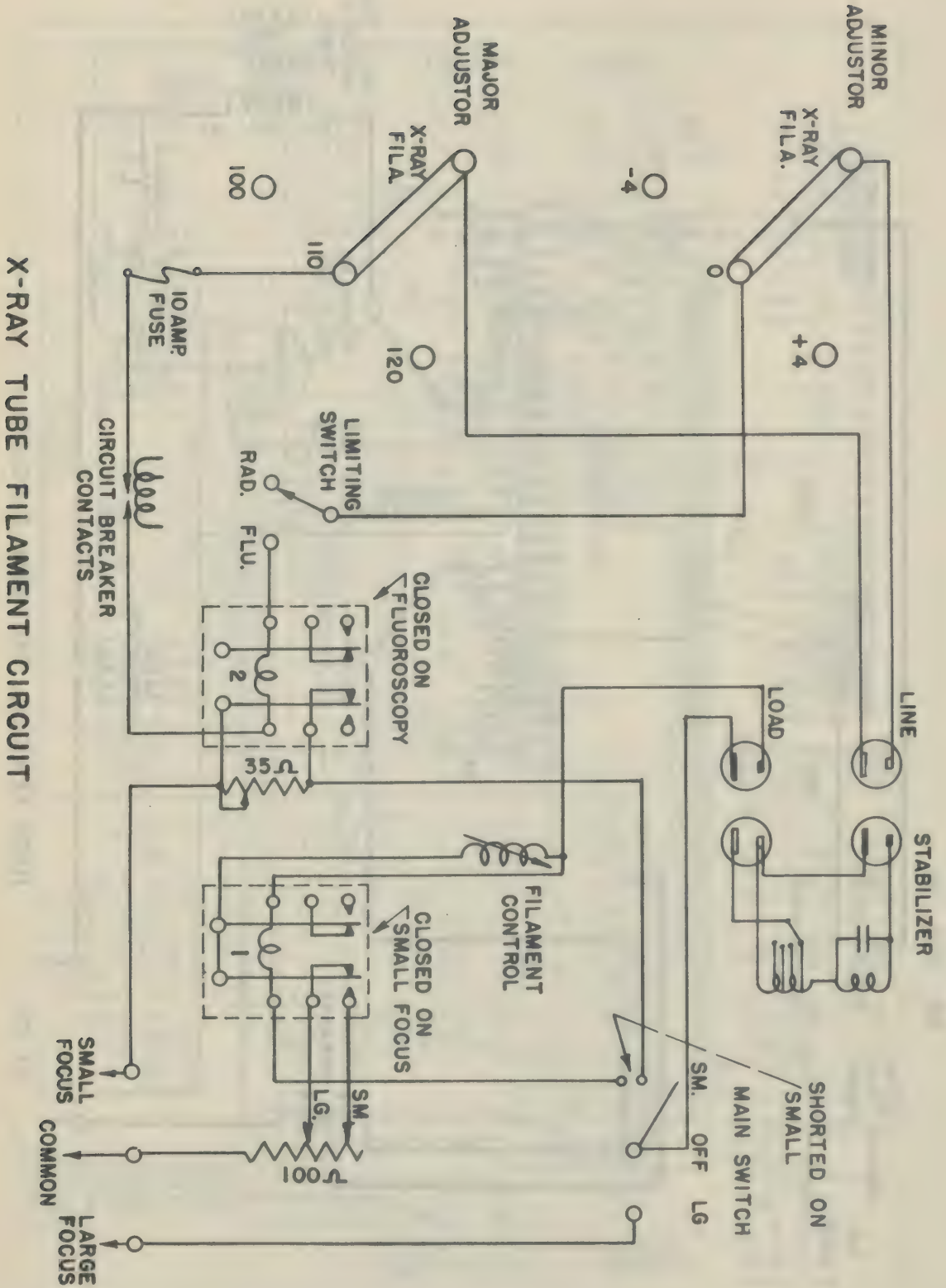
IX. Calibrate at no load (no MA.). Have KV. compensator on control set on 0.

- X. Close sphere gap during actual exposure.
- XI. If pre-reading kilovoltmeter reads incorrect, correct by means of no load resistor.
- XII. Set filament for 3 or 5 M.A. for fluoroscopy. (Footswitch - 0-40 scale of M.A. meter.) Have filament meter deflection near center of meter. (Adjust by means of small focus knob in control)
- XIII. Set filament for 200 M.A. (consult tube rating chart - use on "D" focus, 70 PKV. at 1/10 sec., M.A.S. meter). Determine KVP. by means of sphere gap (average 3 readings):
- XIV. Adjust pre-reading of KV. meter on control to value determined by sphere gap by means of resistor in control use to adjust for maximum line drop.
- XV. If a sphere gap is not available, the pre-reading PKV. meter may be arbitrarily set using an accurate voltmeter 0-250 volt range.
 1. Set the KV. compensator to 0 MA.
 2. Hook voltmeter across the contact terminals of contactor.
 3. Adjust major and minor autotransformer selector switches until voltmeter across contactor reads 136 volts.
 4. Under these conditions, the KV. meter should be set to read 60 KVP. at no load.
 5. Set the KV. compensator to 200 M.A.
 6. Adjust major and minor autotransformer selector switches until voltmeter across contactor reads 175 volts.
 7. Under this condition (step 5 and 6) the KV. meter should be set to read 70 KVP. This will set the meter for load values (based on good line conditions).

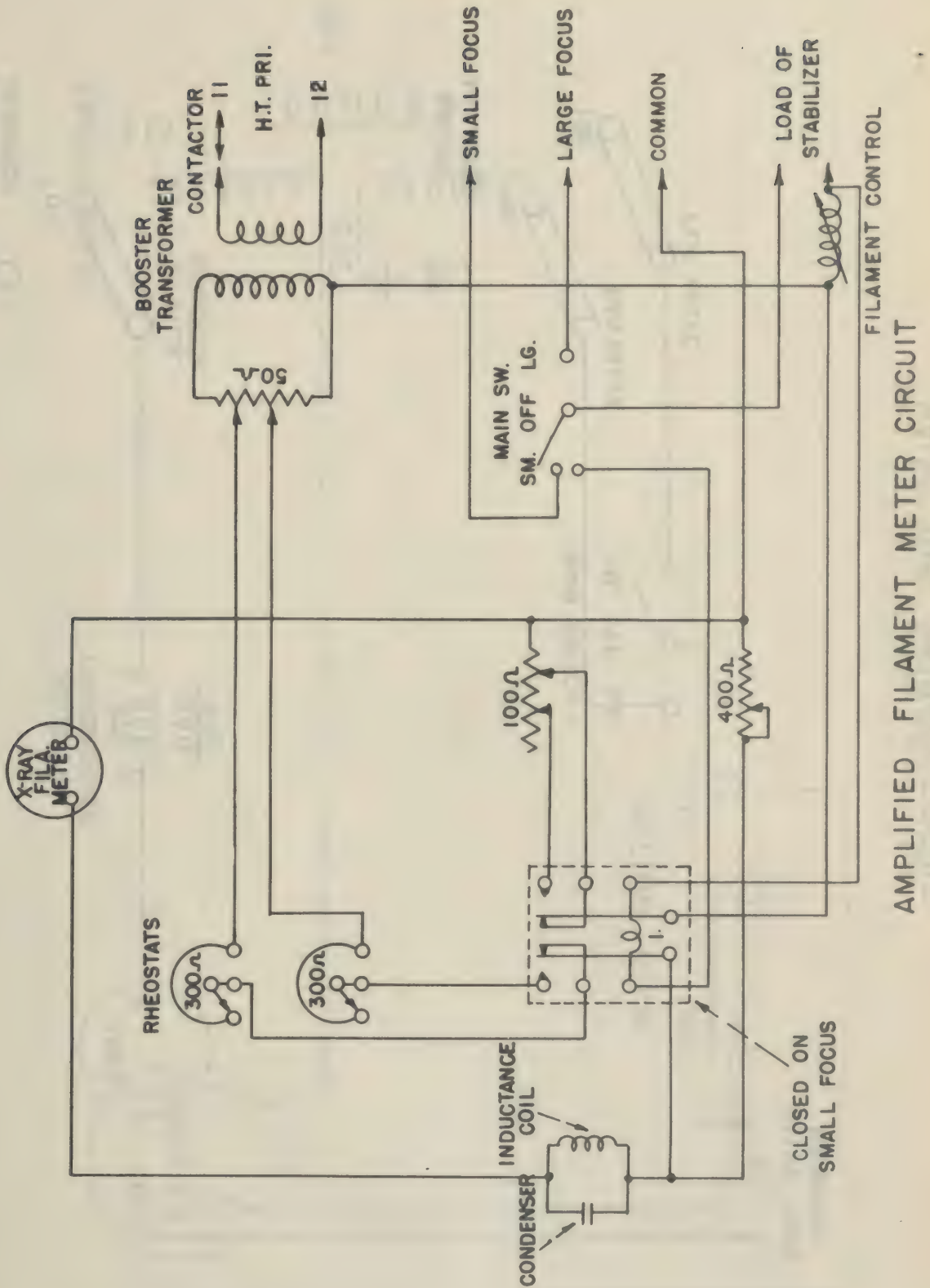
200 MA CONTROL
VIEWED FROM BACK OF CONTROL

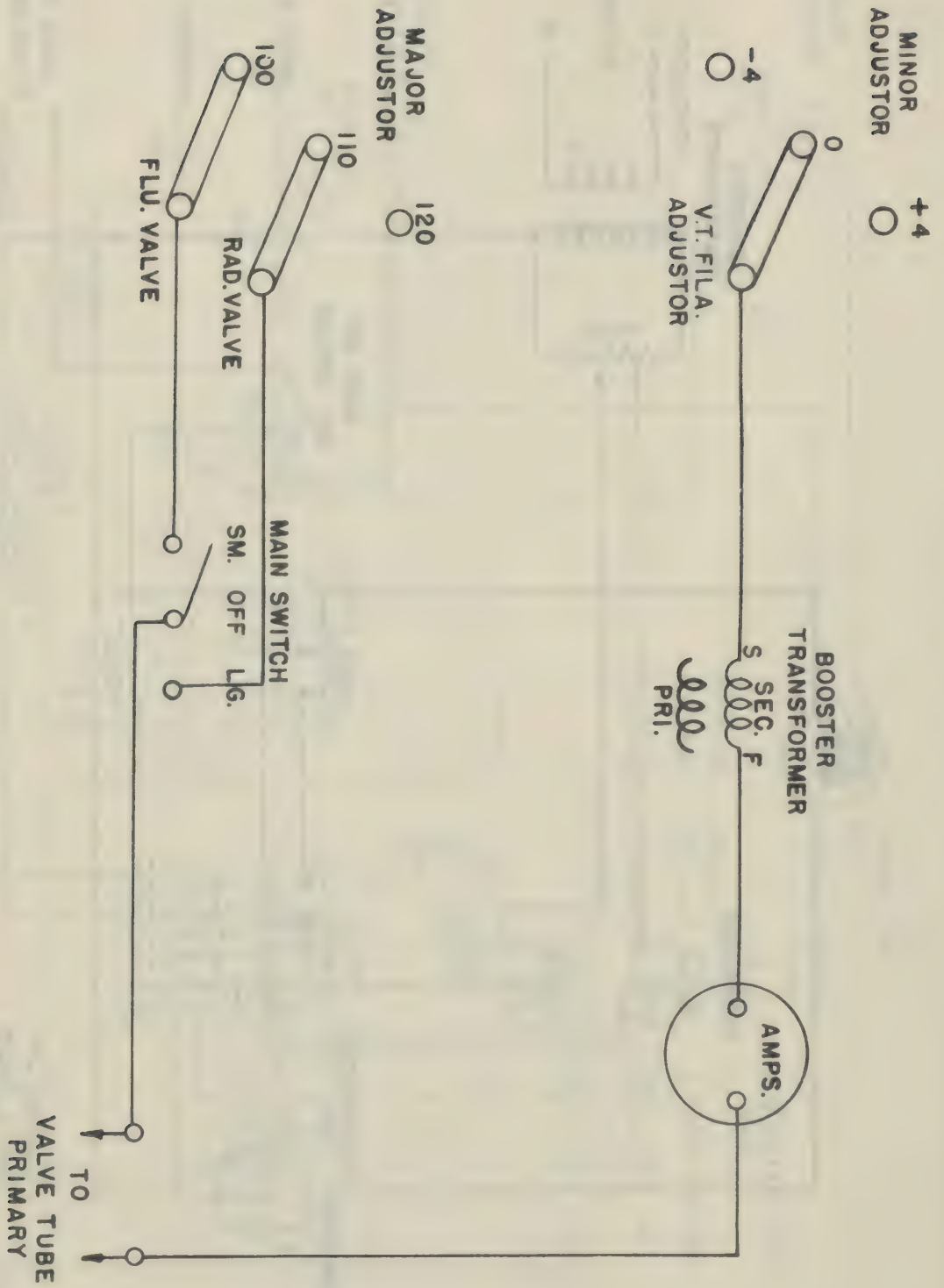






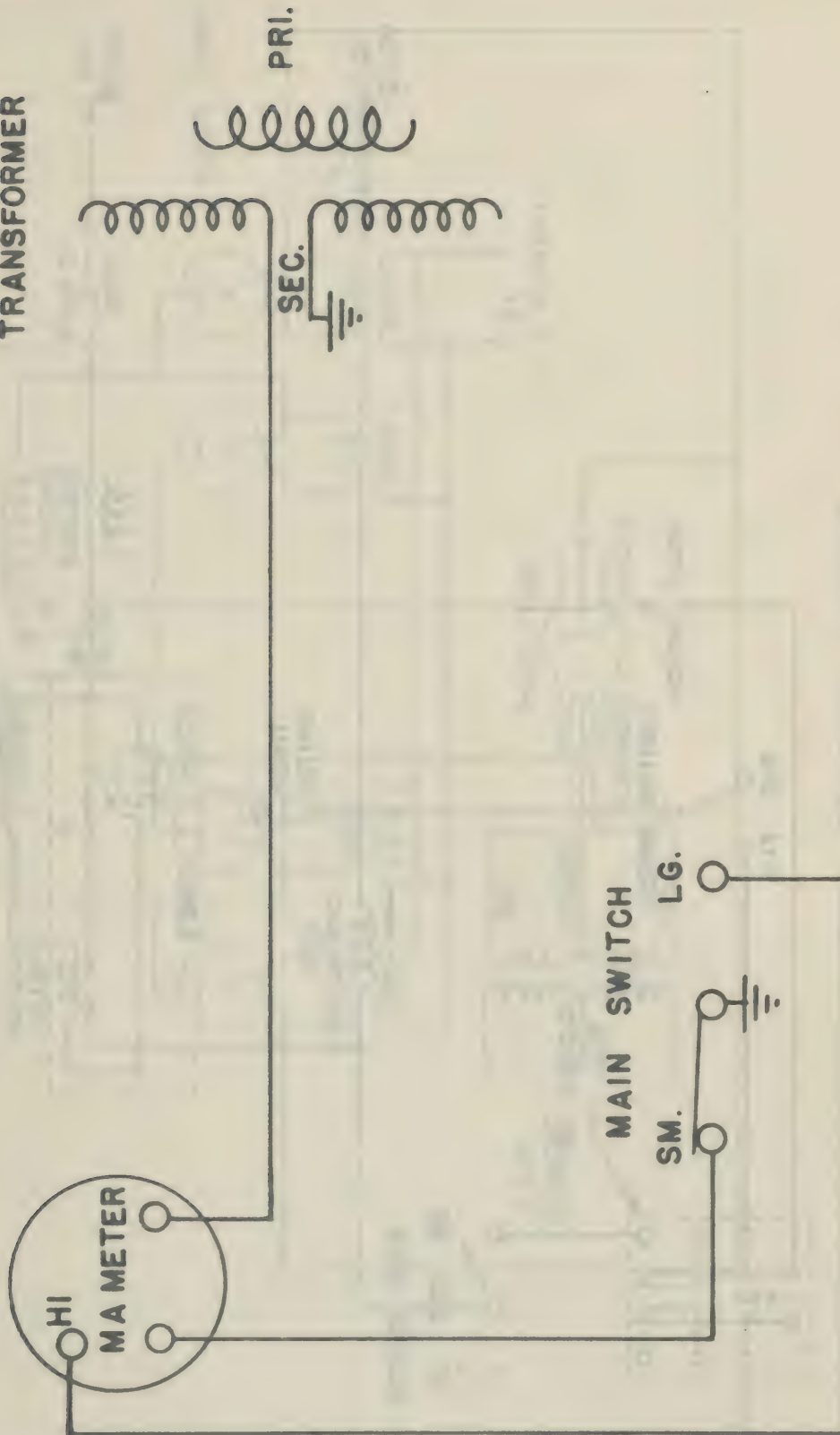
X-RAY TUBE FILAMENT CIRCUIT





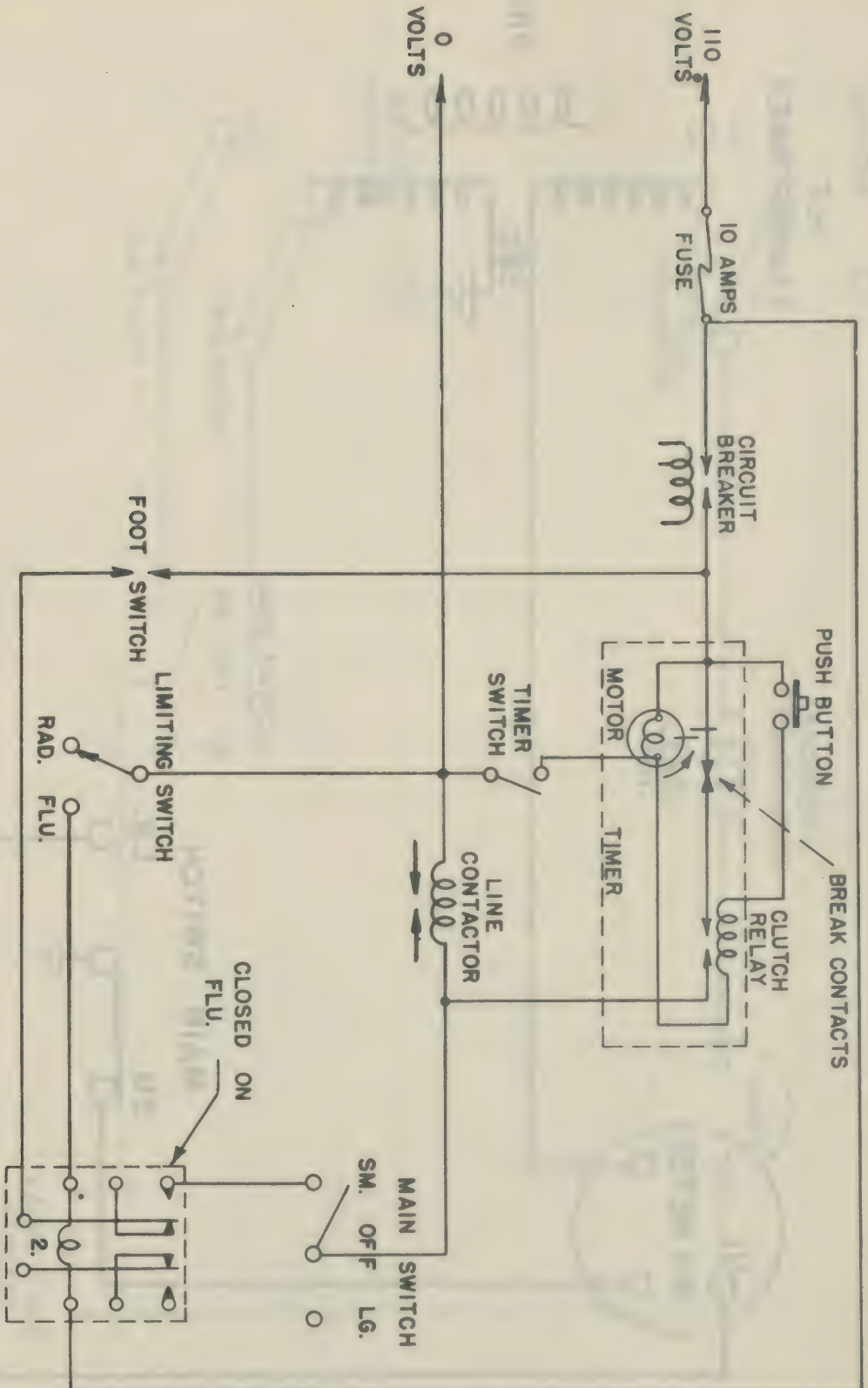
VALVE TUBE PRIMARY CIRCUIT

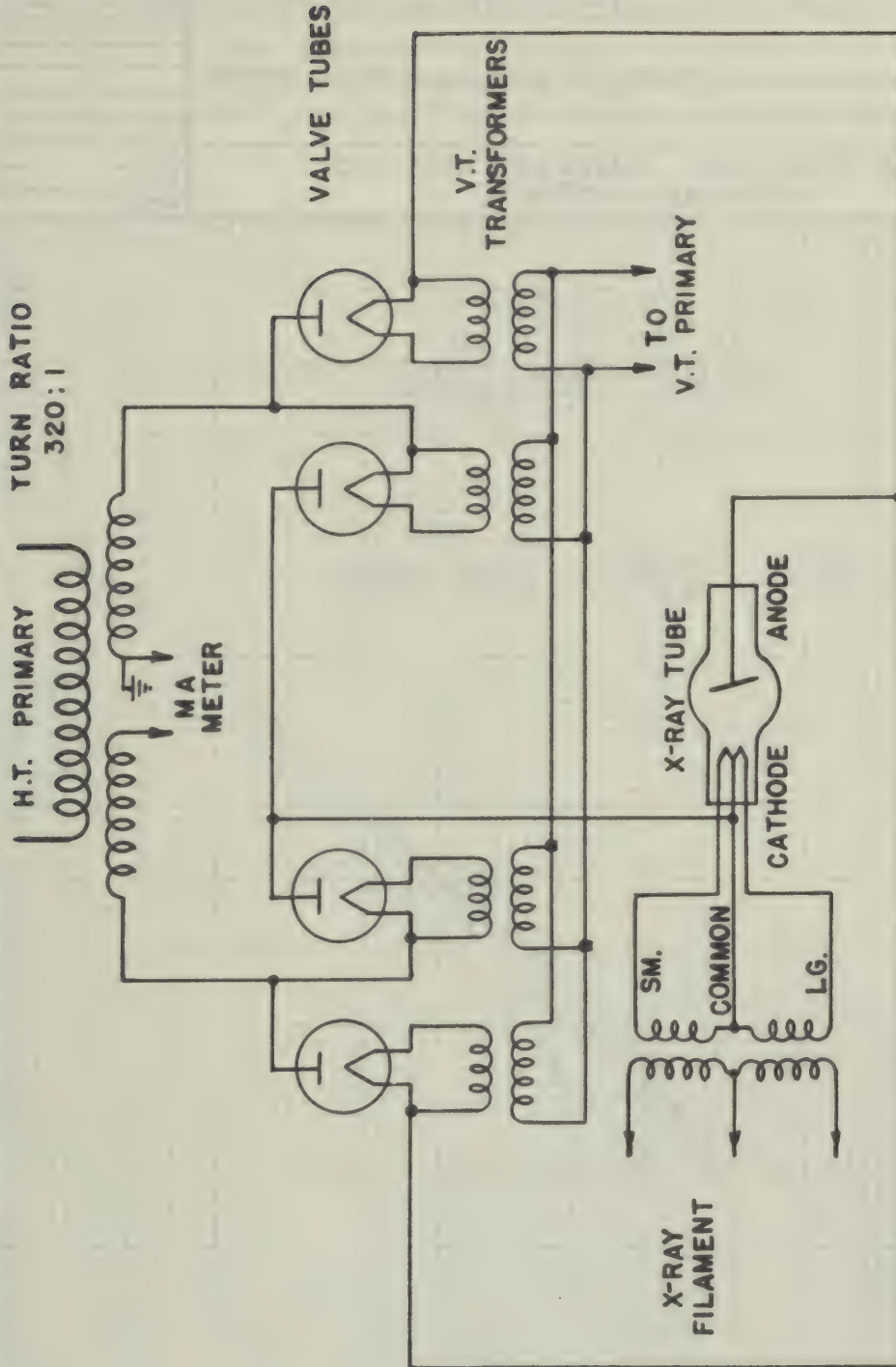
H.T.
TRANSFORMER



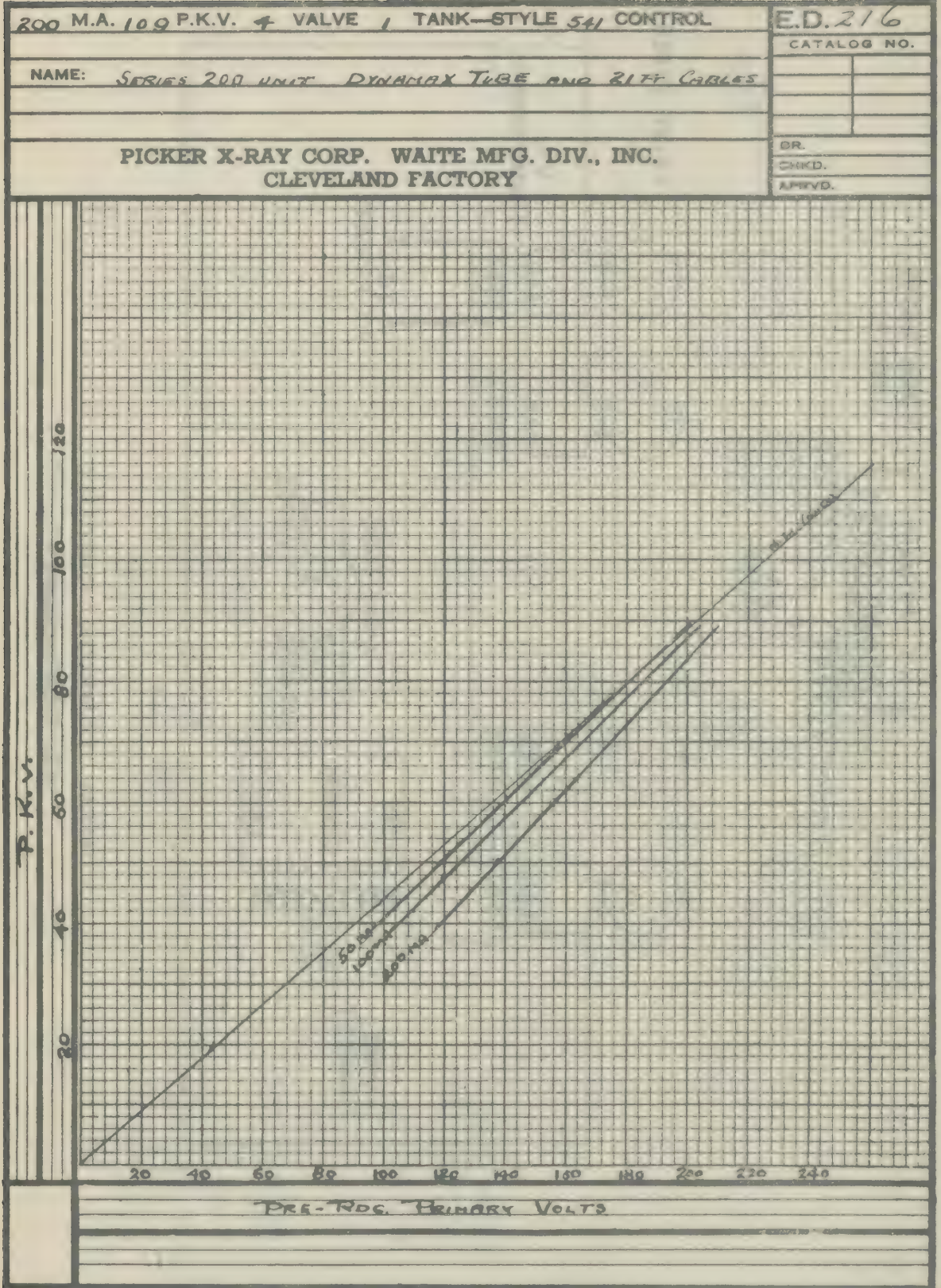
MILLIAMMETER CIRCUIT

OPERATING CIRCUIT





HIGH TENSION CIRCUIT
541 TRANSFORMER



SECTION XLV

200 MA UNIT - GE

200 MA UNIT (GE)

ASSEMBLY AND INSTALLATION DIRECTIONS FOR THE GENERAL ELECTRIC MODEL KX-11 X-RAY UNIT (For Control Stands with Serial #160,925 or Higher) - These directions should be read very carefully before any attempt is made to assemble this equipment.

POWER SERVICE SPECIFICATIONS

Line Voltage	200-260 volts
Frequency	50 or 60 cycles
Safety Switch	250V. - 60 amp.
Line Fuses	250V. - 60 amp.
Pole Transformer	15 kv.a.
Line Conductors	See the following table.

Distance from power trans. to Line Switch	Service Cable Size	Copper Lugs in Service Outlet
0-50	#4 AWG	70 amp.
50-100	#0 AWG	125 amp.
150-200	#00 AWG	150 amp.
Distance from Line Switch to Control Stand	Line Cable Size	
0-25	#6 AWG	
25-50	#4 AWG	
Distance from Control Stand to H.T. Trans.	Primary Cable Size	
0-25	#6 AWG	
25-50	#4 AWG	

The foregoing power specifications will permit operation of the equipment at its maximum capacity.

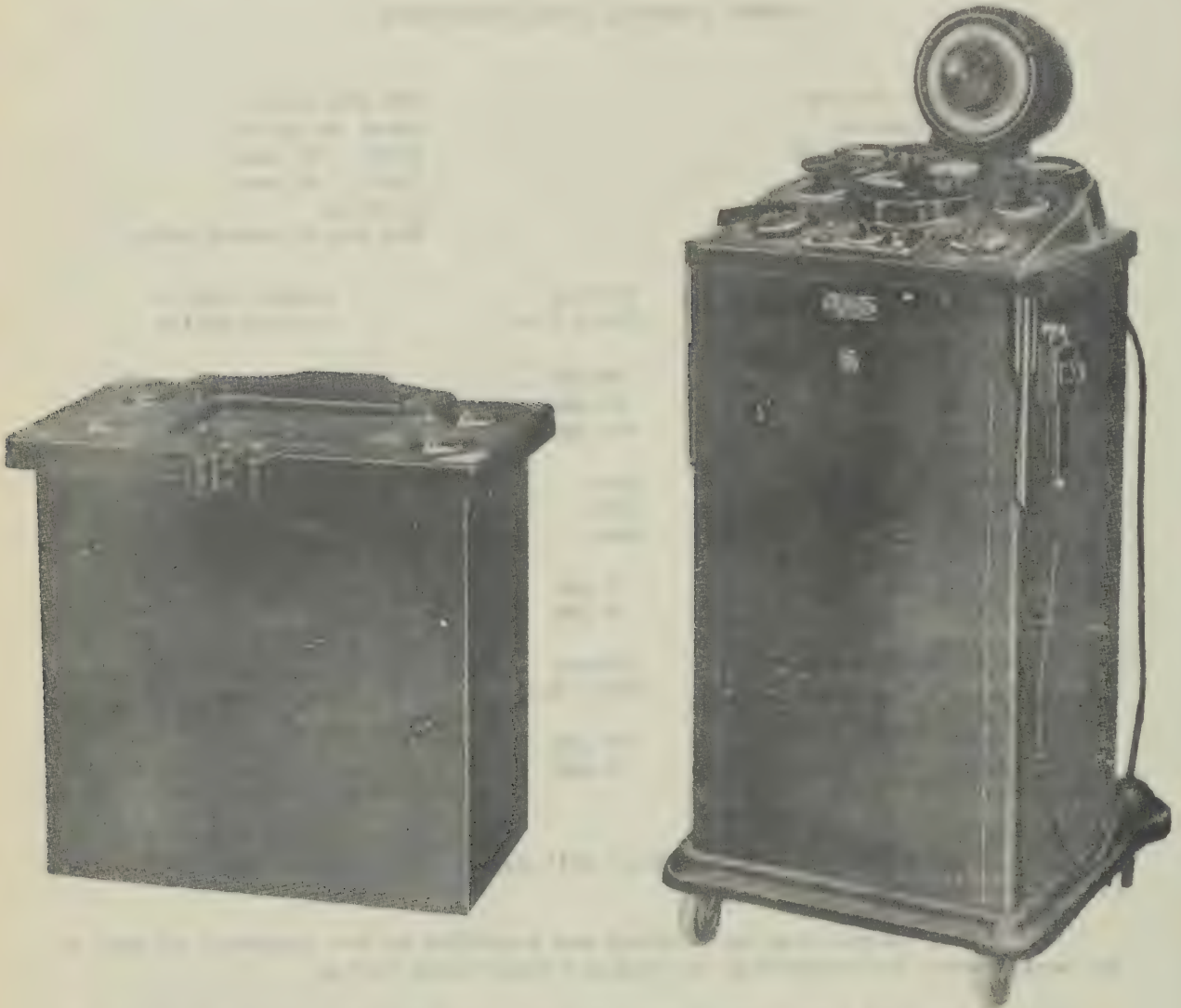
The safety switch must be obtained and installed by the customer, as well as the outlet boxes for connecting the line and transformer cables.

NOTE - When the power supply does not equal the foregoing specifications, the rating of the equipment must necessarily be reduced. Further details are given under "Testing and Adjustment". The wiring from the safety switch to the control and from the control to the rectifier should be installed in rigid conduit whenever feasible.

ASSEMBLY OF EQUIPMENT - Typical layouts of the KX-11 x-ray unit are shown in the following Illustrations. This direction includes information for installing the high voltage rectifier and its control only. Information for installing other related items, such as table, tube stand, etc., will be found in the directions accompanying the respective units.

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THE HIGH VOLTAGE RECTIFIER UNIT - The position of the rectifier unit will depend upon the layout which has been decided upon and will therefore be a matter of choice.



When used in conjunction with a Model 33 Table having plug-in type high voltage cables, the arrangements indicated are considered standard set ups. As shown the rectifier shall be placed directly in line with the head end of the table with a spacing of 5" between the table and the edge of the rectifier unit. If the arrangement shown is used, proper dimensions are shown for placing the high voltage transformer.

After the rectifier has been placed in position, the metal cover shall be

removed by taking out the ten round head machine screws which hold it in place. When doing this, be sure that the cork gasket is not damaged. *NOTE:* To prevent dirt, and moisture from entering the tank, the cover should not remain off any longer than necessary.

Before filling the rectifier with oil, be sure that the four steel hexagonal head cap screws have been removed from the horizontal bakelite strips, and that the four bakelite studs have been installed.

Using a flashlight, inspect the inside of the rectifier thoroughly for damage that may have occurred in shipment. All fastenings on the high tension switch shall be carefully inspected to see that they are tight.

If after examination everything appears to be in order, the four kenotron tubes may be installed. *NOTE -* Before installing the kenotrons, wipe off the glass surface of the tubes with a clean, dry cloth. Be sure that the hands are free from perspiration when handling the tubes. It is best to wear rubber gloves if they are available. Care must be exercised in handling the tubes to prevent breaking the tubulation. When placing the kenotrons in the holders, use both hands and slip the terminals into the holding cups with care, so that the kenotrons are not bumped or jarred.

FILLING THE TRANSFORMER WITH OIL - The oil supplied for this transformer is the highest grade transformer oil obtainable. It is known as G.E. Transil Oil, Cat. A-8002. Every precaution shall be exercised to keep this oil free from foreign particles and moisture.

Therefore, the metal cover must not remain off the transformer any longer than necessary to accomplish the filling process. Do not remove the cover except in a clean dry place. Pour the oil out of the containers into the transformer tank thru the opening until the correct oil level is reached (See Table).

After the kenotrons have been installed, check the oil level in the transformer tank by measuring the air gap between the oil surface and the underneath surface of the transformer cover. The following chart gives the correct air gaps for various ambient temperatures.

Room Temp. Degrees F.	Air Gap Above Oil Surface
60-80	7/8"
81-100	3/4"
101-105	5/8"

The tank is resealed in the following manner. Wipe the gasket dry, using a clean dry cloth, and then apply a thin even coat of fibre grease, supplied with the unit, on the gasket under the cover and on the gasket surface of the tank.

Replace the cover and fasten in place by tightening the screws evenly until the cover is oil tight. Dip the threads of the screws in fibre grease to seal screw holes.

CONNECTING THE TRANSFORMER CABLE - Remove the two screw eyes, by unscrewing them from the tank.

Install the cable clamp beneath the rim of the tank as shown, fastening it in

place with three of the transformer cover bolts. *NOTE:* The leads in the short piece of 1/2" conduit are provided for the Universal Stabilizer when it is used. If the stabilizer is not to be used, this conduit can be removed and placed aside. Cut these leads off and insulate the ends with rubber and friction tape.

Connect the leads in the transformer cable stamped "F-1", "F-2", "MA", "P-2", "P-1", "G", "K-1", "K-2", "TO", "T-1", "T-2", "C", "1", "2", "3", "4", "5", and "6" to the correspondingly marked terminals on the transformer terminal board.

After the transformer cables have been connected, replace the ornamental cover and fasten it in place with the machine screws. Do not connect the control stand end of the transformer cable at this time.

INSTALLING AND POSITIONING THE HIGH VOLTAGE SHOCKPROOF CABLES ON THE TRANSFORMER.

An electrically controlled high voltage change-over switch is incorporated inside the rectifier. This switch is of the two way type, one set of contacts serving the high voltage outlets designated as A and A', and the other set of contacts serving the outlets B and B'.

Consequently the pair of shockproof cables for energizing the particular tube unit must be connected to one of the two sets of outlets marked A and A', and B and B'. The following Illustration indicates the proper cable positions when the transformer is placed directly at the head end of a #33 Table. *Note that the polarity of the tube unit must correspond with the polarity of the high voltage outlets.* Make certain that the set of cables for the tube unit below the table are plugged into the high voltage outlets B and B' as shown, and that the cables for the tube unit above the table are plugged into the outlets A and A'. This is important, so that the tube selector switch on the control stand will operate correctly. Clean the bakelite surfaces of the receptacle and the bushing with a cloth moistened with carbon tetrachloride. Be sure that there is no moisture or foreign matter in the cable receptacle. Allow the parts to dry for a few moments.

Coat the gaskets with a thin even layer of the fibre grease (supplied) and place it over the "plug-in" bushing.

Spread "White Petrolatum Jelly" liberally and evenly all around the entire length of the "plug-in" bushing. There should be a sufficient amount of petrolatum to completely seal the air space in the bushing along its length.

Insert the bushings slowly into the proper receptacles on the rectifier.

It will be noted that each cable bushing is equipped with a locating pin which in turn fits into a keying hole on the receptacle flange. The anode receptacles are stamped "A" and the cathode receptacles are stamped "C".

Align these pins properly and fasten the cable bushings in position using the four fillister head machine screws provided. The small split ornamental rims are then installed over the flange on the cable bushings each half being fastened by two small binding head machine screws.

The high tension shockproof cables are then anchored in place by means of the cable clamp. *NOTE:* When the bushings are sealed in the manner described above,

they may stick in the receptacle so that they cannot be easily removed. The following procedure should be used in removing them to avoid any possibility of breaking the moulded bakelite parts.

1. Remove the split ornamental rims.
2. Remove the four fillister head machine screws which hold the bushing in place.
3. Insert two of these screws just removed into the two threaded holes in the top casting of the bushing.
4. Turn these screws down evenly first one and then the other a little at a time, and the bushing will be forced out of the receptacle.

CAUTION: Be sure that these two screws are turned down carefully together, or the moulded bakelite parts of the bushing may be damaged.

THE CONTROL STAND - The control stand, is shipped completely assembled, except for the rectifier tube, hand switch and foot switch, and the Synchronous Timer which have been removed for shipment.

To afford easy access to the cable clamps, the control stand shall be placed on its side. It is suggested that blocks properly padded be placed under the control stand frame to prevent the top panel from resting on the floor.

The strap, for supporting the transformer cables shall be mounted to the control stand as shown, with the screws and nuts finished.

The right angle connectors on the transformer cable conduits shall be threaded through the strap and fastened in the holes in the adapter plate as shown. Bring the leads up in front of the terminal board. Tip the control stand upright.

The leads in the transformer cable marked "G", "TO", "T1", "T-2", "K2", "K1", "7", "MA", "F1", "S-1", "F2", "1", "2", "3", "4", "5", "6", and "C" shall be connected to the correspondingly marked terminals on the control stand terminal board.

NOTE: If the Universal Stabilizer is not used, the leads stamped "S-1" and "7" shall be insulated with rubber and friction tape and coiled up inside the control stand. A "copper link" must be placed between terminals "7" and "S1" on the control stand terminal board. Units without stabilizers are generally assembled with this link at the factory.

Do not connect the leads to terminals "P1" and "P2" until kenotron filament settings are completed. The line cable shall now be brought into the control stand from the safety switch.

Cut the cable to the proper length and connect to terminals "L1" and "L2" on the control stand terminal board. The conduit fastens at the rear of the control stand by means of a standard conduit fitting. The opening in the casting is not sufficient to pass the conduit fitting on the end of the cable thru it. It will be necessary to loosen the two screws in the base casting which hold this casting, and raise it up enough to pass the conduit fitting thru. (Open the line safety switch and leave it open). Connect the ground lead to "G" at the control stand, and to a water pipe ground at the safety switch end.

WHEN UNIVERSAL STABILIZER IS USED - If a Universal Stabilizer is a part of the installation, it shall be positioned as shown.

Connections to the stabilizer are made with the short length of 1/2" flexible

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conduit containing three leads. The 90° fitting fastens to the bracket on the bottom casting of the stabilizer. Connect the lead stamped "S-1" to the outside terminal stamped either "LINE" or "IN".

On the stabilizer connect lead stamped "C" to one of the two center terminals stamped "Common", and connect lead stamped "7" to the outside terminal stamped either "LOAD" or "OUT".

Remove the copper link which connects terminals "7" and "S-1" on the control stand terminal board. Connect the transformer leads "7" and "S-1" to the correspondingly marked terminals on the control stand terminal board, if these are not already in place.

The lead "C" in the short piece of conduit which leads to the stabilizer connects the common terminal of the stabilizer to terminal "C" on the transformer.

INSTALLING THE S-2 OR S-3 SYNCHRONOUS TIMERS - All leads required for the connection of the synchronous timers will be supplied, mounted and wired into the control stand. The terminals of these leads will be stamped and brought out at the proper place on the control.

Five leads will be found extending thru the hole in the top casting of the control stand and are stamped "1", "2", "3", "4" and "6". Remove the timer mechanism from the box in which it is packed.

CAUTION - Use care in removing the mechanism so that it is not damaged.

The timer housing shall now be mounted on the control as follows. Remove the rear cover of the timer housing and thread the five leads thru the hole in the base casting of the housing and fasten the casting to the rear of the control by means of the three mounting screws provided.

Next insert the timer mechanism and fasten it in place on the casting using the 4 flat head machine screws furnished.

Connect the leads to the correspondingly marked terminals on the timer terminal board, and replace the cover on the rear of the timer.

Fasten the ornamental trim on the front of the timer using the three fillister head machine screws furnished. The slot in trim should be at the top.

GROUNDING METER RECTIFIER - The control stand will be furnished with the meter rectifier, installed and wired. The 83 type rectifier tube which has been shipped separately, must be installed in the four prong socket of the meter rectifier.

KENOTRON INDICATOR - The kenotron indicator is a device which conveniently informs the operator when a kenotron filament has burned out. If a kenotron filament is burned out the indicator will glow red. The control stand is shipped with the indicator completely assembled.

NOTE - The operation of the kenotron filament indicator is somewhat critical.

After installing a new set of kenotrons during installation or the replacement of a kenotron later, a tap adjustment on the kenotron indicator terminal board may be necessary to make the indicator function properly. The kenotron indicator lamp should not glow when all of the kenotron filaments are lighted regardless of the position of the technic selector setting on radiography, therapy or fluoroscopy.

200 MA UNIT (GE)

If the indicator lamp should glow when the kenotron filaments are lighted, change the brass link K-3 on the kenotron indicator terminal board so that the lamp does not glow for any of the positions of the technic selector.

After the tap adjustment has been made, check the operation of the indicator by removing successive kenotrons from their mounting and checking to see that the indicator lamp does glow for technic selector positions of radiography, fluoroscopy, and therapy after each kenotron has been removed.

FOOT SWITCH - The cable for the foot switch shall be pulled thru a conduit to the control stand. The cable leads are connected to correspondingly marked terminals "10", "11" and "G" on the control stand terminal board.

HAND SWITCH - The cable for the hand switch is threaded thru the rubber grommet in the right side panel. The length of cable outside the control shall be such that the loop of the cable does not touch the floor when the hand switch is placed on the hook. A strain release clamp is provided on the side panel near the rubber grommet, for anchoring the cable. Thread the cable around inside the control stand to take care of the slack and connect the leads to correspondingly marked terminals "14", "10" & "20".

Tie the cable to the other leads inside the control stand and position it so that it does not interfere with any of the switches and is not too close to any of the resistors.

IMPULSE TIMER - If an Impulse Timer is a part of the installation, refer to the directions accompanying that piece of equipment.

RT-1-2 TUBE AND PROTECTIVE RELAY, 115 VOLTS, 50 OR 60 CYCLES - If an RT-1-2 Rotating Anode Tube Unit is used, the link connected between terminals "15" and "16" on the control stand terminal board shall be removed.

Connections for the tube unit and relay shall be made as follows, using #14 rubber covered wire.

Protective Relay Terminal	Connected To		Control Stand Terminal
G	"	"	G
L-1	"	"	1
L-2	"	"	0
T-1	"	"	16
T-2	"	"	15
			Motor Lead
M-1	"	"	1
M-2	"	"	2
M-3	"	"	3

NOTE - For RT-1-2 Casings - When the RT-1-2 casing is supplied with a 230 volt stator winding it will be necessary to change the connections on the x-ray switch interlock on KX-11 controls. Ordinarily these interlock contacts are connected to "115" on the terminal board. When a 230 volt stator is used these contacts should be connected "0". This is done by shifting the lead from these contacts normally connected on "115" to "0" on the back of the control stand terminal board. The power for the 230V. stator will then be taken from "1" and "230".

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When the RT-1-2 tube is included in the installation, the connections on the middle board of the technic selector switch must be changed. The two switches mounted on this board have identical buttons and segments. The switch which controls the kenotron filament temperature is the switch on the right when viewed from the front of the control. The switch on the left is the milliammeter scale changing switch.

Remove the lead connected to the third button of the switch which controls the kenotron filament voltage (the contacts of the switch rest on this button when the switch is placed on "Radiography Small Focus"). Insulate this lead with rubber and friction tape and tie it to the other leads so that it does not interfere with any of the moving parts of the control.

Connect the first and the third buttons of this switch together by a short lead or else by a link (13/16" between center of the holes).

Remove the link connecting the third button to the segment of the milliammeter scale changing switch. Connect the first button to the third button on this switch by a short lead or link.

The purpose of these connections is to provide for energizing the small focus of the RT-1-2 tube up to 200 ma.

Check the voltage from C to K2 to see that it is the same for "radiography Large Focus" and "Radiography Small Focus". (102.0 volts).

The 0-250 range of the milliammeter should now be read for both "Radiography Large Focus" and "Radiography Small Focus". If any doubt exists as to these connections, check the control stand meter against another meter. This test meter may be inserted in series with one of the leads connected to the terminals of the meter rectifier unit stamped "+ " or "-".

TESTING AND ADJUSTMENT - When the installation is complete, go back over all connections and check to be sure that they have been properly made and that the connections are all tight. It is important that all line or primary conductors and fastenings are of proper size and securely fastened.

CIRCUIT BREAKER - The Model KX-11 Control Stand is provided with an automatic circuit breaker, which is located at the upper left side of the control.

The normal position of the breaker is with the handle towards the "ON" position.

When the circuit breaker trips, the handle moves to a position midway between "ON" and "OFF" positions. Service can be restored by moving the circuit breaker handle to the "OFF" position and then to the "ON" positions. If the handle remains in the "ON" position, the machine is again ready for operation.

If the handle does not remain in the "ON" position, the cause for the breaker to trip has not been remedied, or the handle has not been moved all the way to the "OFF" position when resetting it.

Measure the line voltage at the safety switch and place the line voltage adjustment link (located on the left side of the terminal board) on its proper terminal. The table below should be followed in doing this.

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Line Voltage

240-270
*220-250
200-230

Place Strap On

H
M
L

***NOTE:** The link is connected in the factory to M and should be used whenever possible. The 10 volts overlap is provided to handle unusual line voltage fluctuations.

The line and x-ray combination switch is a three-position switch. These positions are :

1. OFF - No power supplied to the auto transformer.
2. ON - Control stand is energized. Filaments of the x-ray tube and kenotrons are lighted.
3. X-RAY Connections are made so that an exposure will be made when the timer operates. When the unit is used for therapy without the treatment timer, the exposure starts when the switch is placed in this position. An interlock is provided so that the stator of the RT-tube is energized when the switch is placed in this position if this tube is used in the installation.

When the line switch is in the intermediate position, the filaments of the kenotrons and the x-ray tube should light. The x-ray tube filament ammeter should read less than 3.0 amperes on the zero setting of the filament regulator.

Adjust the line compensator so that the pointer of the compensator voltmeter is on the center line. The compensator control should not be moved unless the line switch is in the "OFF" position to avoid arcing and burning of the contacts.

Check the rotating anode tube (if this tube is to be used) to make sure that the anode is stationary in the intermediate position of the switch and rotating in the "X-Ray" position.

Next measure the voltage applied to the kenotron filament transformers. Adjust the x-ray tube filament current to 5.0 amperes and measure the voltage between "K2" and "C" on the control stand terminal board with the technic selector on "RADIOGRAPHY". Repeat with the technic selector on "FLUOROSCOPY".

NOTE: Be sure all four kenotrons are lighted.

The following table gives the values of voltages for the proper kenotron filament settings, when either SP or DX tube units are used:

Technic Selector Switch Position	Volts C-K2	Actual Kenotron Terminal Filament Voltages
Radiography (Large Focus)	102	9.6 (200 ma. emission)
Radiography (Small Focus)	96	8.6 (50 ma. emission)
Fluoroscopy or Therapy	87	8.2 (10 ma. emission)

In case the voltage is not as specified (check your voltmeter first) adjust the upper movable band of the booster resistor (located inside at the left rear of the control) to the position which will give the proper value.

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With everything in readiness complete the primary connections of the leads "P-1" and "P-2" to the control stand terminal board. Place the cord tips to give maximum clearance between cord tips and control panel. These leads had been left off for safety reasons. Set the kilovolt selector on "auto transformer" control button 1, and the technic selector on "Radiography Large Focus". Adjust the filament current to about 3.6 amperes. Set the time for two seconds, make the exposure and read the milliammeter. This should be under 20 ma. Check over the complete installation while operating at this low technic.

A slight deflection of the milliammeter will be noticeable when the line switch is closed. This should not be interpreted as a faulty condition. This is normal and is due to the "Edison Effect" in the rectifier tube. The milliammeter should be adjusted to zero (by means of the Zero adjustment on the meter) when the line switch is in the "OFF" position. No error will be introduced in the milliammeter reading above 2 ma. by the "Edison Effect".

The filament booster should now be adjusted. This has been adjusted at the factory, but because of variable line conditions, it is necessary to readjust it on each installation. Set the kilovolt selector on button "30" and the timer for 0.2 seconds, and adjust the filament current for a tube current of 100 ma. This will have to be done according to the directions in the tube instruction manual. When a stabilizer is to be used, connect it to the unit. Adjust the booster transformer band so that the voltage across "K-2" to "C" remains constant (or increases less than 0.5 volt) for the technic described above.

After adjusting the booster, check the kenotron filament voltages again to see that they have not been changed. Adjust them again, if necessary.

The next step is to check the line regulation in order to select the proper line calibration chart found with the operating instructions. This is done as follows:

1. Connect a voltmeter having a full scale deflection of 250 or 300 volts to terminals "0" and "230".
2. Set the kilovolt selector on button "37" (80 kv.p.)
3. Set the timer for a three second exposure.
4. Adjust the filament current to give 50 ma. x-ray tube current. Use the large focus of the tube.
5. Make the exposure and read the voltmeter during the exposure.
6. Terminate the exposure and read the voltmeter.
7. Select the calibration chart on the basis of the technic below.

Difference in the two voltmeter readings

Use Chart No.

0 to 1	1
1 to 2	2
2 to 3	3
3 to 4	4
4 to 5	5
5 to 6.5	6

After the proper calibration chart has been selected, it shall be removed and placed where it will be convenient for the operator.

Check the equipment on fluoroscopy technic. The technic selector should be placed on fluoroscopy and the timer set accordingly. Check the unit over the entire fluoroscopic range.

CALIBRATION CHART FOR GENERAL ELECTRIC MODEL KX-11 X-RAY UNIT

RADIOGRAPHY										FLUOROSCOPY AND THERAPY		
Kv.P.	10-30 Ma.	50 Ma.	100 Ma.	150 Ma.	200 Ma.	Kv.P.	Kv.P.	Kv.P.	Kv. SELECTOR 3-5 Ma.	Kv.P.	Kv. SELECTOR 3-5 Ma.	
30.0					5	30.0	34.0	34.0	1	83.6	31	
31.8				2	6	31.8	35.7	35.7	2	85.2	32	
33.6			1	3	7	33.6	37.3	37.3	3	86.9	33	
35.4			2	4	8	35.4	39.0	39.0	4	88.5	34	
37.3		1	3	5	9	37.3	40.6	40.6	5	90.2	35	
39.1		2	4	6								
40.9		3	5	7	10	39.1	42.3	42.3	6	91.8	36	
42.7		4	6	8	11	40.9	43.9	43.9	7	93.5	37	
44.5		5	7	9	12	42.7	45.6	45.6	8	95.1	38	
46.4		6	8	10	13	44.5	47.2	47.2	9	96.8	39	
		7	9	11	14	46.4	48.9	48.9	10	98.4	40	
48.2	6											
50.0	7			12	15	48.2	50.5	50.5	11	100.5	41	
51.9	8		10	13	16	50.0	52.2	52.2	12			
53.7	9		11	14	17	51.9	53.8	53.8	13			
55.5	10		12	15	18	53.7	55.5	55.5	14			
	11		13	16	19	55.5	57.2	57.2	15			
57.3	12		14	17	20	57.3	58.8	58.8	16			
59.2	13		15	18	21	59.2	60.5	60.5	17			
61.0	14		16	19	22	61.0	62.1	62.1	18			
62.8	15		17	20	23	62.8	63.8	63.8	19			
64.6	16		18	21	24	64.6	65.4	65.4	20			
	17											
66.5	18			22	25	66.5	67.0	67.0	21			
68.3	19		20	23	26	68.3	68.7	68.7	22			
70.1	20		21	24	27	70.1	70.4	70.4	23			
71.9	21		22	25	28	71.9	72.0	72.0	24			
73.8	22		23	26	29	73.8	73.7	73.7	25			
	23											
75.6	24		24	27	30	75.6	75.3	75.3	26			
77.4	25		25	28	31	77.4	77.0	77.0	27			
79.2	26		26	29	32	79.2	78.6	78.6	28			
81.1	27		27	30	33	81.1	80.3	80.3	29			
82.9	28		28	31	34	82.9	81.9	81.9	30			
	29											
84.7	30		29	32	35	84.7						
86.5	31		30	33	36	86.5						
88.4	32		31	34	37	88.4						
90.2	33		32	35	38	90.2						
92.0	34		33	36	39	92.0						
	35											
93.8	36		34	37	40	93.8						
95.7	37		35	38	41	95.7						
97.5	38		36	39	42	97.5						
99.3	39		37	40	43	99.3						
101.1	40		38	41	44	101.1						
	41											
103.0	42					103.0						
104.8	43					104.8						
106.6	44					106.6						
108.4	45					108.4						
110.3	46					110.3						

CALIBRATION CHART FOR GENERAL ELECTRIC MODEL KX-11 X-RAY UNIT

RADIOGRAPHY						FLUOROSCOPY AND THERAPY				
Kv. P.	10-30 Ma.	KILOVOLT SELECTOR BUTTON				Kv. P.	Kv. P.	KV. SELECTOR 3-5 Ma.	Kv. P.	KV. SELECTOR 3-5 Ma.
		50 Ma.	100 Ma.	150 Ma.	200 Ma.					
30.0						30.0	34.0	1	83.6	31
31.8						31.8	35.7	2	85.2	32
33.6						33.6	37.3	3	86.9	33
35.4						35.4	39.0	4	88.5	34
37.2		1				37.2	40.6	5	90.2	35
39.0	1	2				39.0	42.3	6	91.8	36
40.8	2	3				40.8	43.9	7	93.5	37
42.6	3	4				42.6	45.6	8	95.1	38
44.4	4	5				44.4	47.2	9	96.8	39
46.2	5	6				46.2	48.9	10	98.4	40
48.0	6	7				48.0	50.5		100.0	
49.8	7	8				49.8	52.2	11		41
51.6	8	9				51.6	53.8	12		
53.4	9	10				53.4	55.5	13		
55.2	10	11				55.2	57.2	14		
57.0	11	12				57.0	58.8	15		
58.8	12	13				58.8	60.5	16		
60.6	13	14				60.6	62.1	17		
62.4	14	15				62.4	63.8	18		
64.2	15	16				64.2	65.4	19		
66.0	16	17				66.0	67.0	20		
67.8	17	18				67.8	68.7	21		
69.6	18	19				69.6	70.4	22		
71.4	19	20				71.4	72.0	23		
73.2	20	21				73.2	73.7	24		
75.0	21	22				75.0	75.3	25		
76.8	22	23				76.8	77.0	26		
78.6	23	24				78.6	78.6	27		
80.4	24	25				80.4	80.3	28		
82.2	25	26				82.2	81.9	29		
84.0	26	27				84.0		30		
85.8	27	28				85.8				
87.6	28	29				87.6				
89.4	29	30				89.4				
91.2	30	31				91.2				
93.0	31	32				93.0				
94.8	32	33				94.8				
96.6	33	34				96.6				
98.4	34	35				98.4				
100.2	35	36				100.2				
102.0						102.0				
103.8						103.8				
105.6						105.6				
107.4						107.4				
109.2	40					109.2				

CALIBRATION CHART FOR GENERAL ELECTRIC MODEL KX-II X-RAY UNIT

RADIOGRAPHY						FLUOROSCOPY AND THERAPY			
Kv.P.	KILOVOLT SELECTOR BUTTON					Kv.P.	Kv. SELECTOR 3-5 Ma.	Kv.P.	Kv. SELECTOR 3-5 Ma.
	10-30 Ma.	50 Ma.	100 Ma.	150 Ma.	200 Ma.				
30.0					7	30.0	1	83.6	31
31.8			1	2	8	31.8	2	85.2	32
33.6			2	3	9	33.6	3	86.9	33
35.4			3	4	10	35.4	4	88.5	34
37.2		1	4	5	11	37.2	5	90.2	35
39.0		2	5	6	12	39.0	6	91.8	36
40.8	1								
42.5	2	3	6	8	13	40.8	7	93.5	37
44.3	3	4	7	9	14	42.5	8	95.1	38
46.1	4	5	8	10	15	44.3	9	96.8	39
47.9	5	6	9	11	16	46.1	10	98.4	40
49.7	6	7	10	12	17	47.9	11	100.0	41
	7	8	11	13	18	49.7	12		
51.5	8	9	12	14	19	51.5	13		
53.3	9	10	13	15	20	53.3	14		
55.0	10	11	14	16	21	55.0	15		
56.8	11	12	15	17	22	56.8	16		
58.6	12	13	16	18	23	58.6	17		
60.4	13	14	17	19	24	60.4	18		
62.2	14	15	18	20	25	62.2	19		
64.0	15	16	19	21	26	64.0	20		
65.8	16	17	20	22	27	65.8	21		
67.6	17	18	21	23	28	67.6	22		
69.3	18	19	22	24	29	69.3	23		
71.1	19	20	23	25	30	71.1	24		
72.9	20	21	24	26	31	72.9	25		
74.7	21	22	25	27	32	74.7	26		
76.5	22	23	26	28	33	76.5	27		
78.3	23	24	27	29	34	78.3	28		
80.1	24	25	28	30	35	80.1	29		
81.8	25	26	29	31	36	81.8	30		
83.6	26	27	30	32	37	83.6			
85.4	27	28	31	33	38	85.4			
87.2	28	29	32	34	39	87.2			
89.0	29	30	33	35	40	89.0			
90.8	30	31	34	36	41	90.8			
92.6	31	32	35	37	42	92.6			
94.3	32	33	36	38	43	94.3			
96.1	33	34	37	39	44	96.1			
97.9	34	35	38	40	45	97.9			
99.7	35	36	39	41	46	99.7			
101.5	36					101.5			
103.3	37					103.3			
105.1	38					105.1			
106.8	39					106.8			
108.6	40					108.6			
109.4	41					109.4			

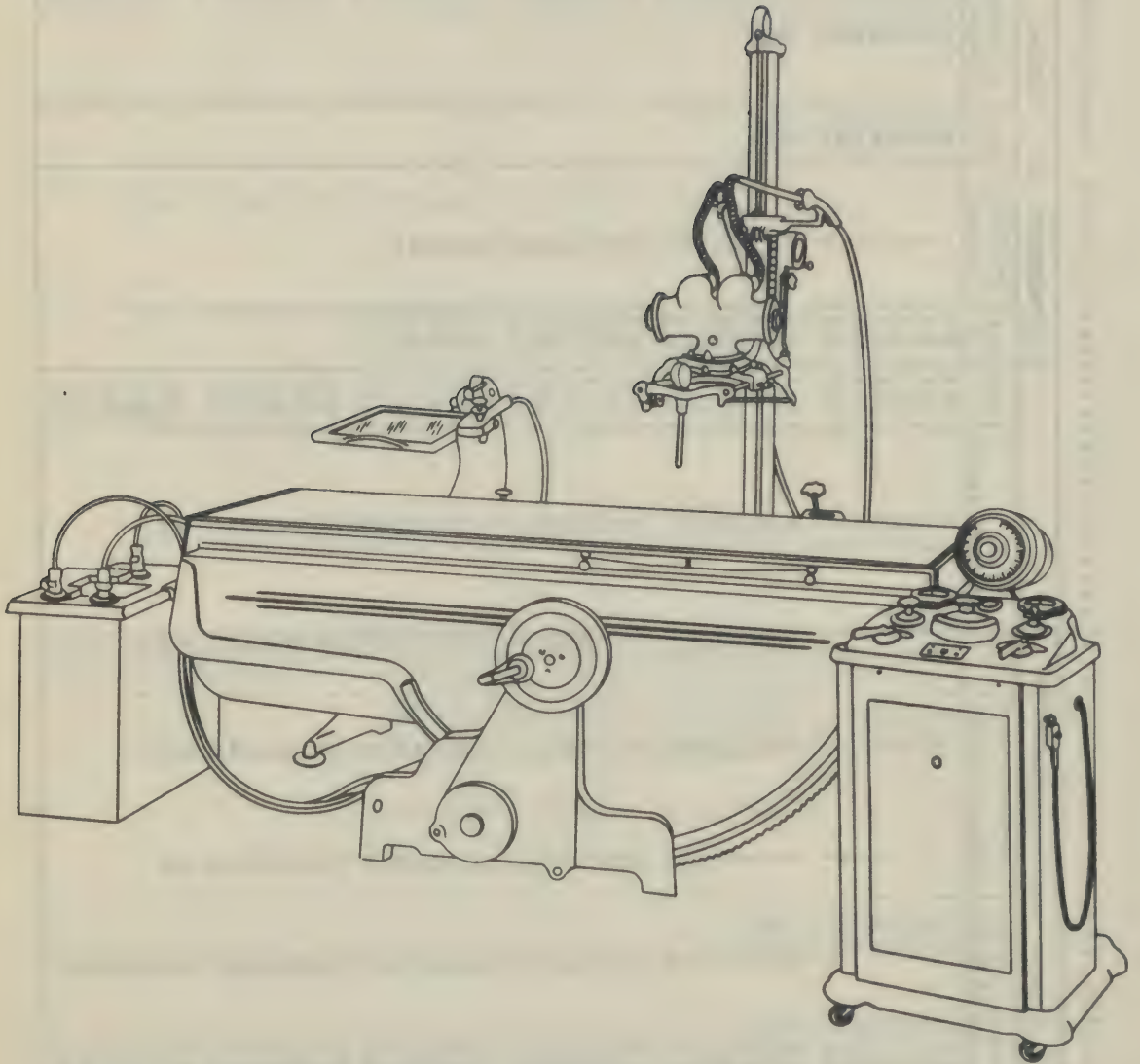
CALIBRATION CHART FOR GENERAL ELECTRIC MODEL KX-11 X-RAY UNIT

RADIOGRAPHY						FLUOROSCOPY AND THERAPY			
Kv.P.	10-30 Ma.	50 Ma.	100 Ma.	150 Ma.	200 Ma.	Kv.P.	Kv.P.	Kv. SELECTOR 3-5 Ma.	Kv.P. 3-5 Ma.
30.0				2	7	30.0	34.0	1	83.6
31.7				3	8	31.7	35.7	2	85.2
33.4			1	4	9	33.4	37.3	3	86.9
35.1			2	5	10	35.1	39.0	4	88.5
36.8			3	6	11	36.8	40.6	5	90.2
38.6		1	4	7	12	38.6	42.3	6	91.8
40.3	1	2	5	8	13	40.3	43.9	7	93.5
42.0	2	3	6	9	14	42.0	45.6	8	95.1
43.7	3	4	7	10	15	43.7	47.2	9	96.8
45.4	4	5	8	11	16	45.4	48.9	10	98.4
47.2	5	6	9	12	17	47.2	50.5	11	100.0
48.9	6	7	10	13	18	48.9	52.2	12	
50.6	7	8	11	14	19	50.6	53.8	13	
52.3	8	9	12	15	20	52.3	55.5	14	
54.0	9	10	13	16	21	54.0	57.2	15	
55.8	10	11	14	17	22	55.8	58.8	16	
57.5	11	12	15	18	23	57.5	60.5	17	
59.2	12	13	16	19	24	59.2	62.1	18	
60.9	13	14	17	20	25	60.9	63.8	19	
62.6	14	15	18	21	26	62.6	65.4	20	
64.4	15	16	19	22	27	64.4	67.0	21	
66.1	16	17	20	23	28	66.1	68.7	22	
67.8	17	18	21	24	29	67.8	70.4	23	
69.5	18	19	22	25	30	69.5	72.0	24	
71.2	19	20	23	26	31	71.2	73.7	25	
73.0	20	21	24	27	32	73.0	75.3	26	
74.7	21	22	25	28	33	74.7	77.0	27	
76.4	22	23	26	29	34	76.4	78.6	28	
78.1	23	24	27	30	35	78.1	80.3	29	
79.8	24	25	28	31	36	79.8	81.9	30	
81.6	25	26	29	32	37	81.6			
83.3	26	27	30	33	38	83.3			
85.0	27	28	31	34	39	85.0			
86.7	28	29	32	35	40	86.7			
88.4	29	30	33	36	41	88.4			
90.2	30	31	34	37	42	90.2			
91.9	31	32	35	38	43	91.9			
93.6	32	33	36	39	44	93.6			
95.3	33	34	37	40	45	95.3			
97.0	34	35	38	41	46	97.0			
98.8	35	36	39	42	47	98.8			
100.5	36	37	40	43	48	100.5			
102.2	37					102.2			
103.9	38					103.9			
105.6	39					105.6			
107.4	40					107.4			
109.1	41					109.1			
110.8	42					110.8			

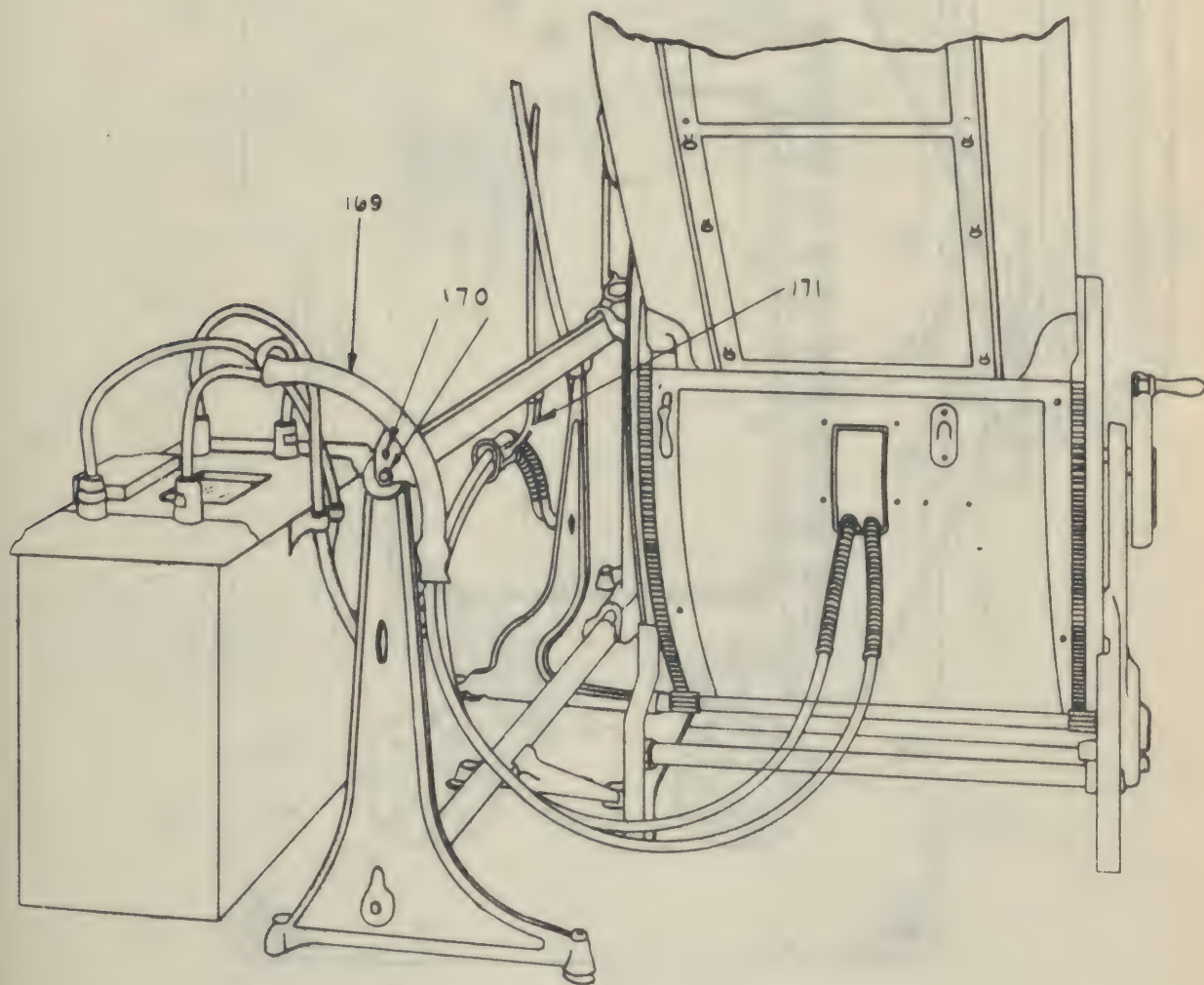
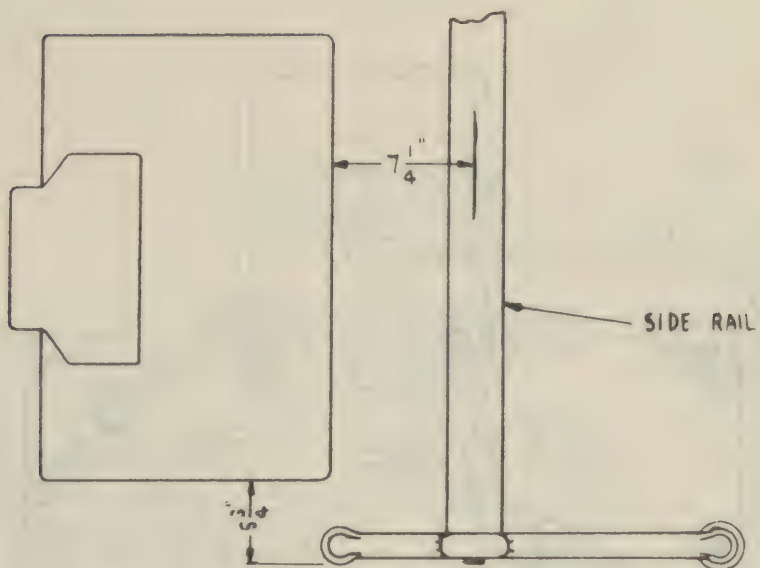
CALIBRATION CHART FOR GENERAL ELECTRIC MODEL KX-11 X-RAY UNIT

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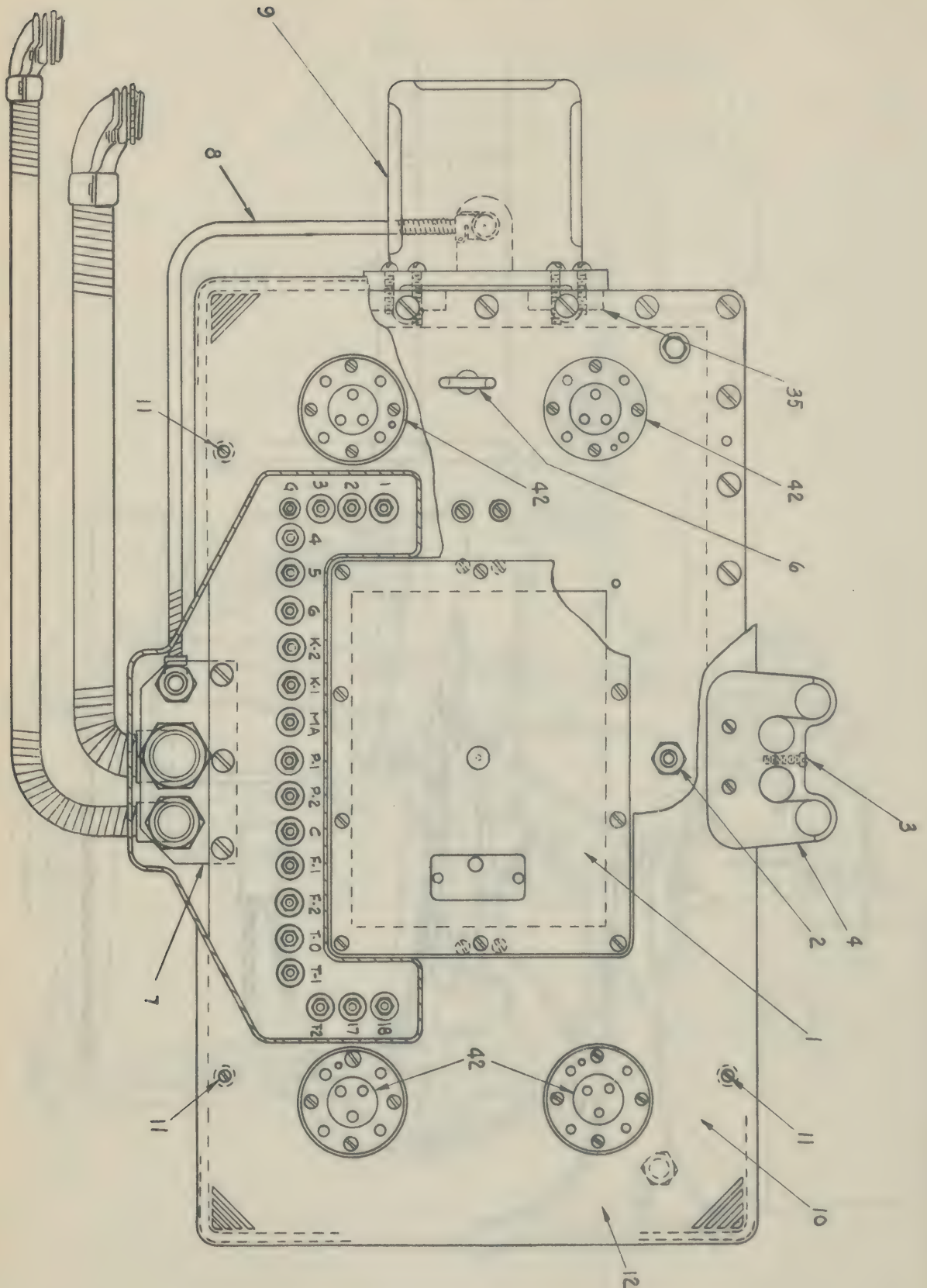
200 MA UNIT (GE)



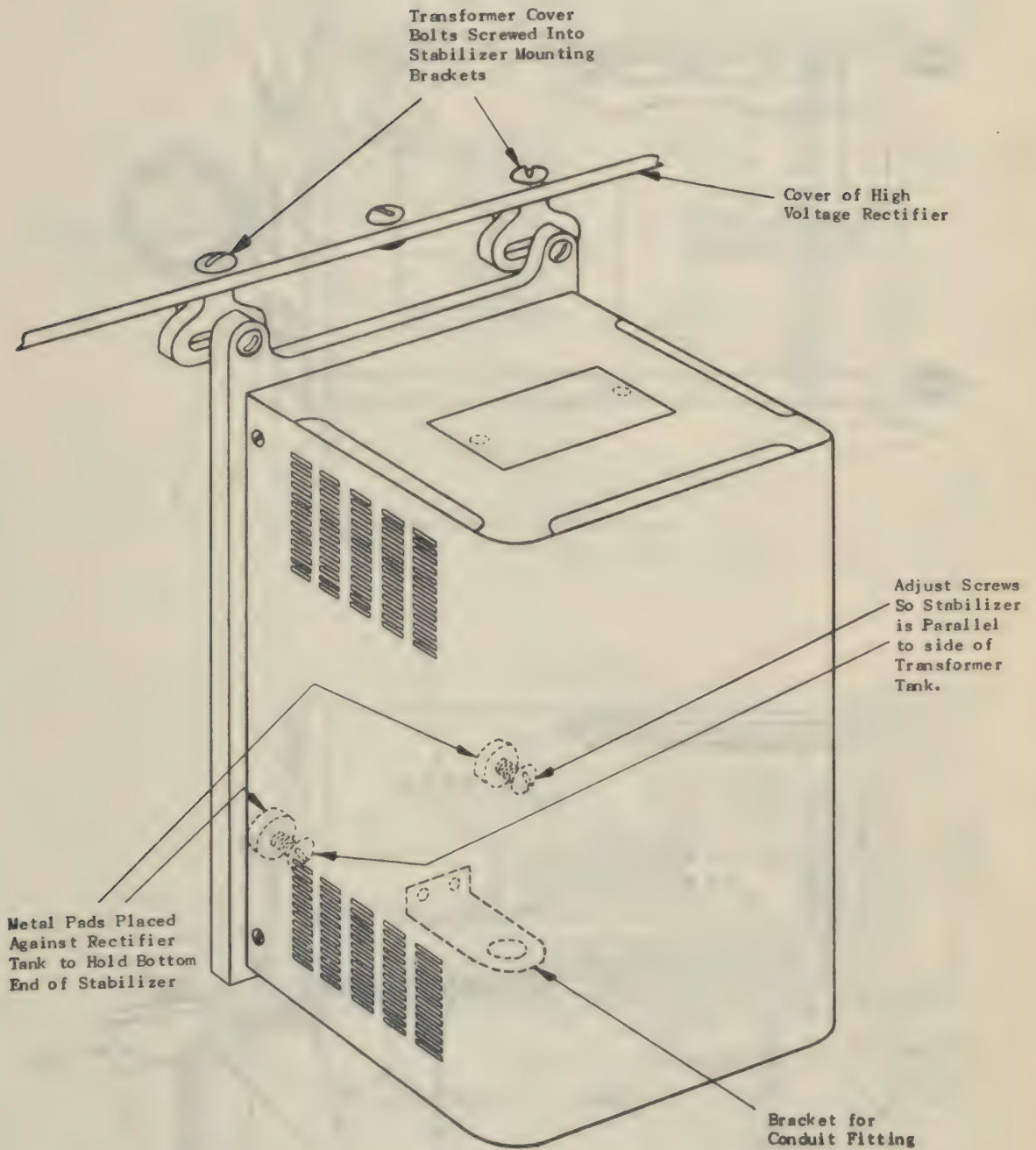
200 MA UNIT (GE)

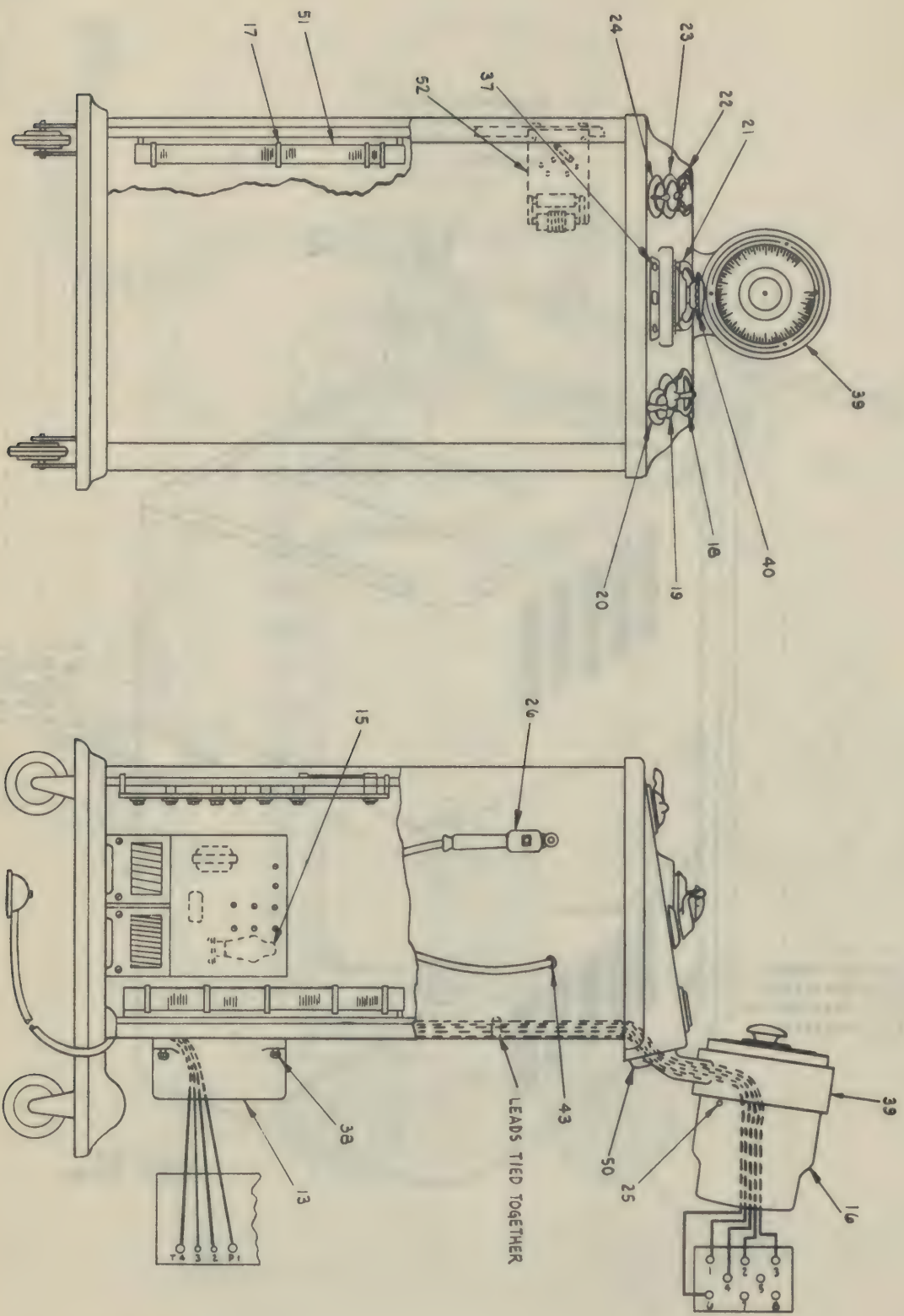


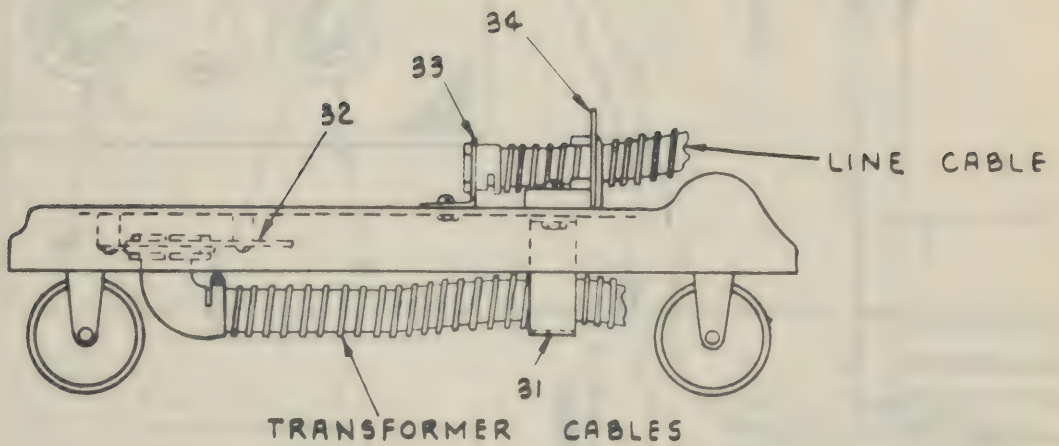
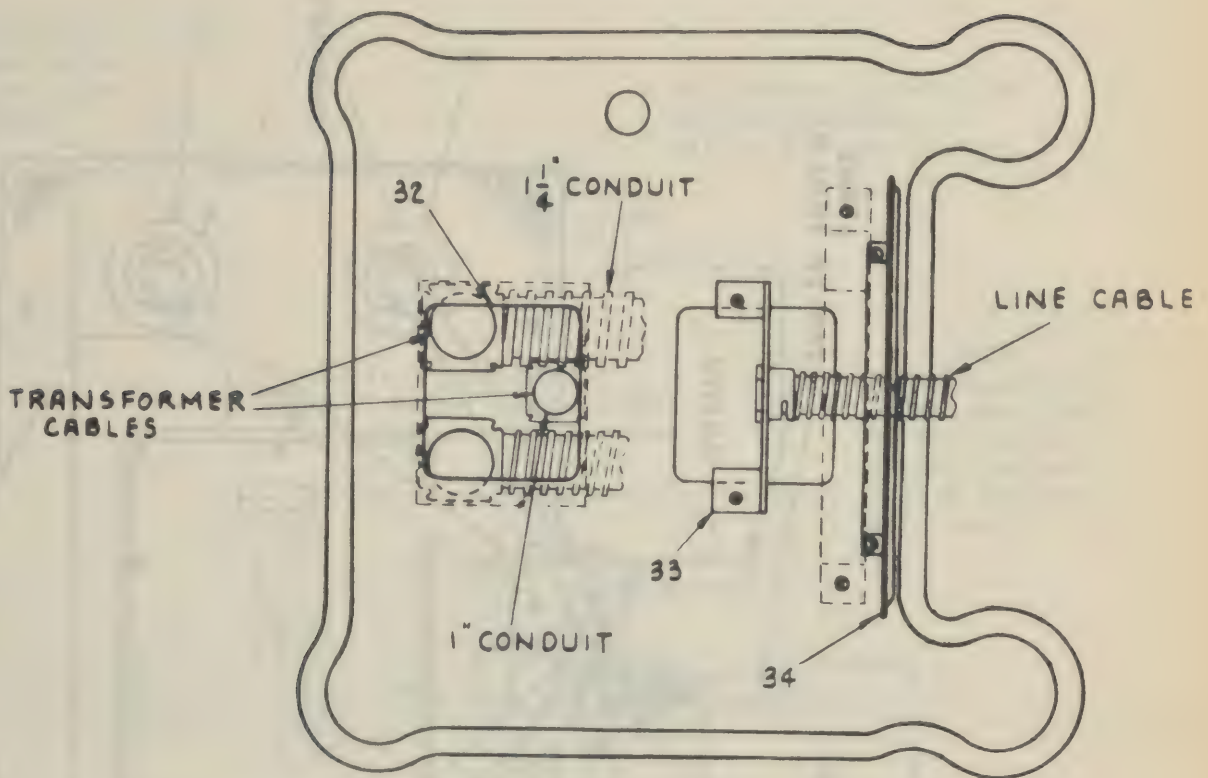
200 MA UNIT (CE)

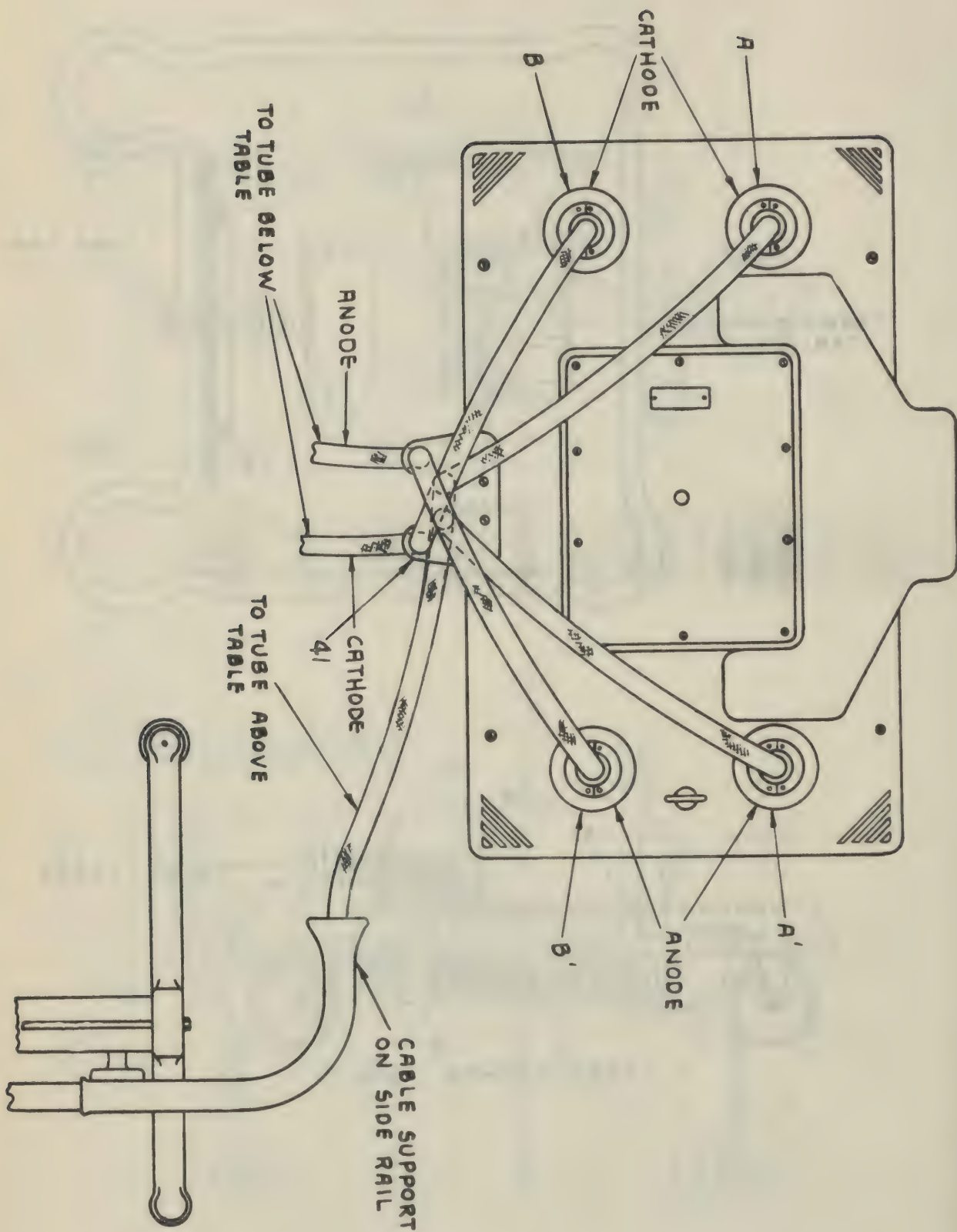


200 MA UNIT (GE)









200 MA UNIT (GE)

Fluoroscopic
Room Red or
Green light
fixture.

Fluoroscopic Light On and
Off Switch Mounted on
Wall in Fluoroscopic Room.

Normally Closed Contact
115 V. Relay. Operates When
Timer Contactor is Energized

NOTE
Wiring From Fluor-
oscopic Room Light
and Wall Switch to
Control Junction
Shall Be Furnished
By Customer.

Type S-2 or S-3
Synchronous Timer
Magnetic Contactor
Mounted In Control
Stand.

Connect These Wires
To A 115 V. Power Supply
Independent of Control
Stand Power Supply. This
Wiring Furnished by
Customer.

DIAGRAM SHOWING METHOD OF
CONNECTING FLUOROSCOPIC ROOM LIGHT
TO X-RAY CONTROL STAND

200 MA UNIT (GE)

THERAPY - In case any therapy is to be done with the apparatus, a therapy timer should be provided to control the treatment. The unit should be operated at its rated capacity (5 ma. 100 kv.p.) and the apparatus observed to see if everything is operating satisfactorily. The technic selector should be set on "Therapy" in order to provide sufficient ballast resistance for the x-ray tube. To connect the therapy timer, remove the link on the terminal board connecting "T-3" to "T-4" and connect the switch of the timer across these two terminals.

In case a therapy timer is not used and the therapy treatments are to be controlled with the combination line and x-ray switch, the equipment should be operated in this manner. With the line switch in the "OFF" position, set the kilovolt selector on button 52, and the technic selector on "Therapy". Close the line switch to the "ON" position and adjust the filament current to give about 5 ma. Close the line switch to the "X-Ray" position and observe the milliammeter. Adjust the x-ray filament current to give 5 ma.

When no therapy is to be done with the apparatus, it is recommended that the copper link connecting "T3" and "T4" be removed to prevent any accidental energizing of the apparatus.

For further information regarding the operation and maintenance of the KX-11 Kenotron X-ray Unit, refer to the directions for operation accompanying the equipment.

FLUOROSCOPIC ROOM LIGHT - Provision has been made for controlling a fluoroscopic room light if desired.

A relay for controlling the fluoroscopic room light is mounted on the rear of the magnetic contactor for the synchronous timer.

Wiring connections to this relay and the fluoroscopic room light are shown.

BUCKY INTERLOCK - Directions for connecting the Bucky Interlock System to this unit will be found in the Directions accompanying the table.

For operation of this apparatus, refer to the Directions for Operation which are furnished.

DIRECTIONS FOR INSTALLING BOOSTER TRANSFORMER ON A GENERAL ELECTRIC KX-11 X-RAY UNIT

GENERAL - In order to install the booster transformer, it will be necessary to remove the high voltage cables from the KX-11 rectifier unit, and remove the ornamental cover. The necessary information for doing this will be found in the standard directions #11056G for Installing the KX-11, a copy of which is being furnished.

The booster transformer is furnished completely assembled with the necessary connecting leads attached.

Using the machine screws furnished, mount the transformer in place on the KX-11 rectifier unit as shown in the attached view #1. Tapped holes are provided in the studs on the booster transformer assembly for the machine screws which fasten it to the rectifier.

WIRING - The three leads stamped "O", "315" and "265" which extend from the

200 MA UNIT (GE)

Place Washer (Furnished)
Between Mtg. Stud and Tank

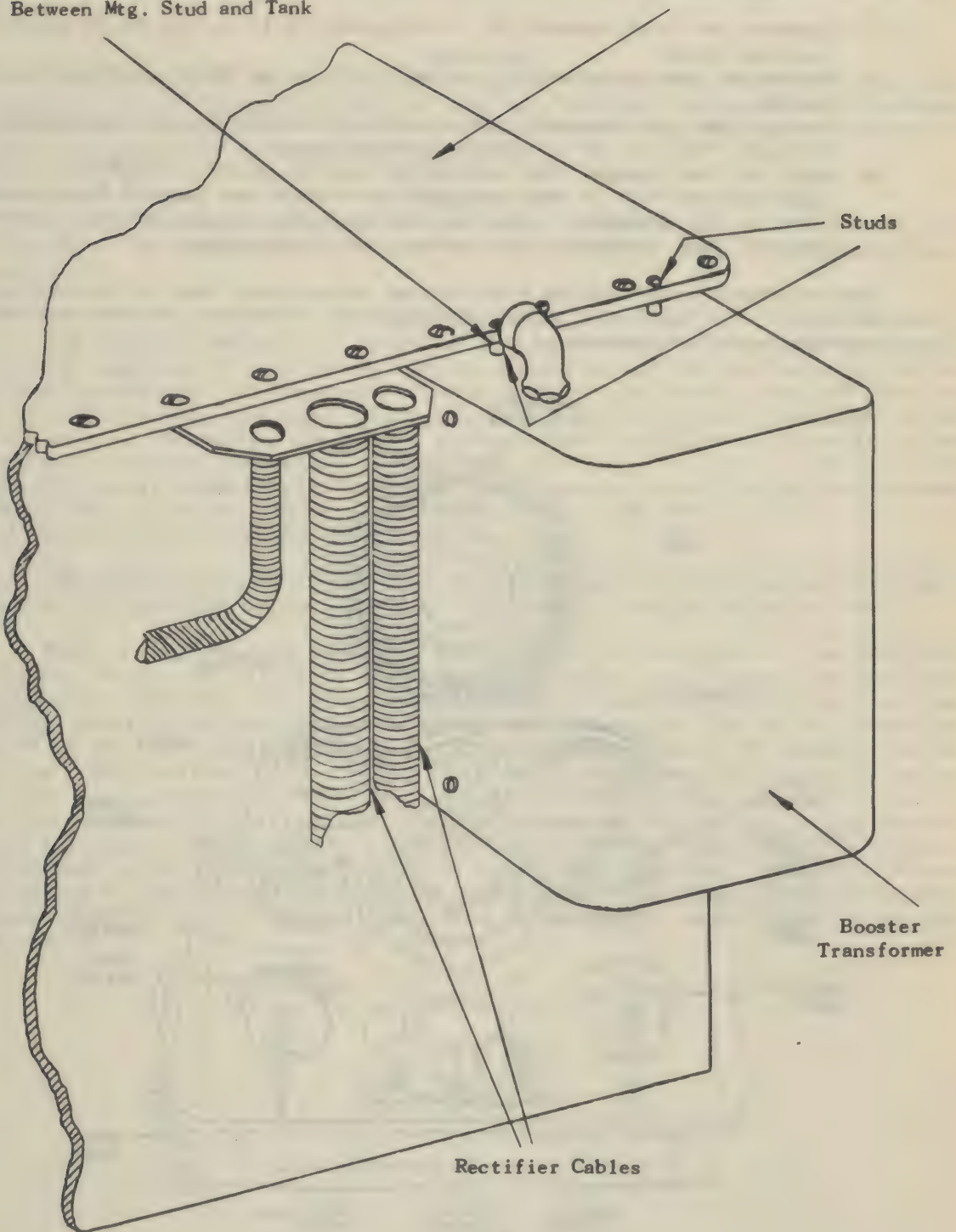
KX-11 Rectifier

Studs

Booster
Transformer

Rectifier Cables

VIEW #1

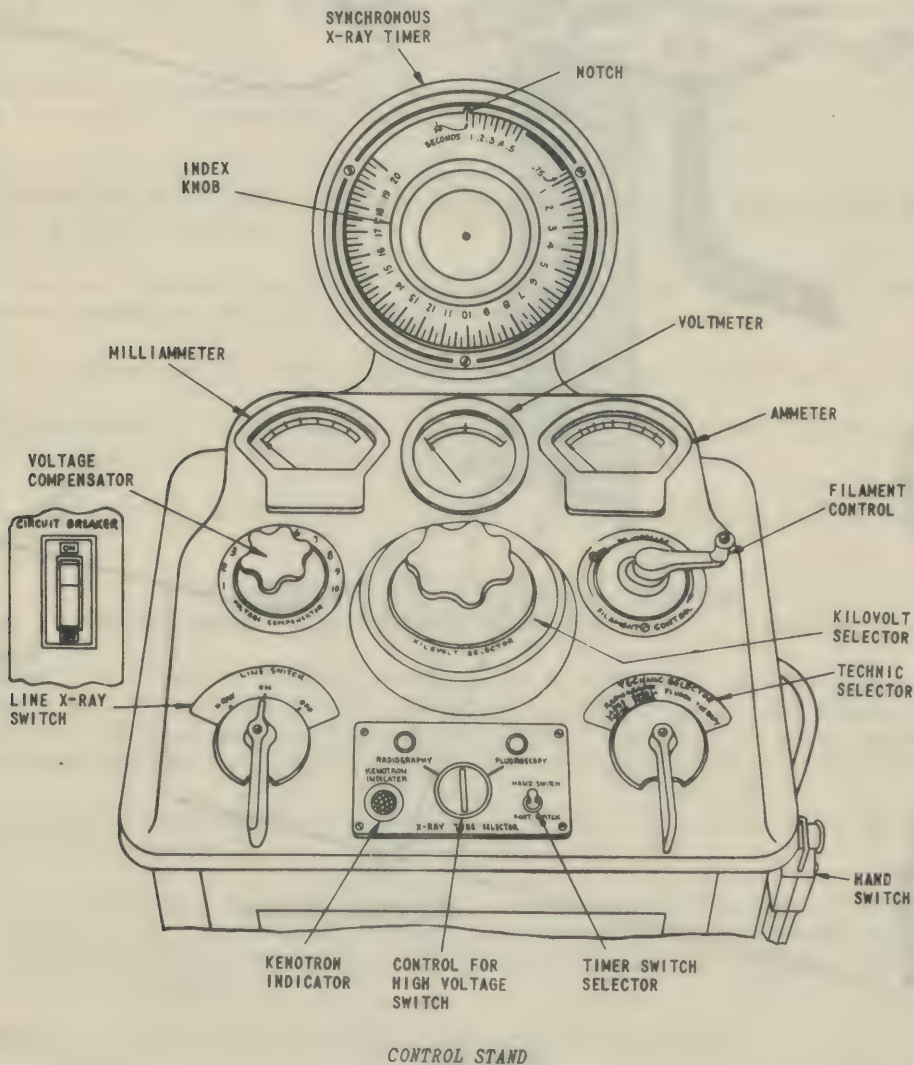


200 MA UNIT (GE)

booster transformer shall be connected as follows:

1. Connect the lead stamped "O" to terminal "P-1" on the KX-11 rectifier terminal board.
2. Remove the lead connected to terminal "P-2" on the KX-11 rectifier terminal board.
3. Connect the lead stamped "315" extending from the booster transformer to terminal "P-2" on the rectifier terminal board.
4. Bolt the lead stamped "265" extending from the booster transformer, to the lead stamped "P-2" in the rectifier cable which was removed from terminal "P-2" on the rectifier. Use the machine screw, washer and nut supplied. Insulate this connection with rubber and friction tape.

The ornamental cover and the high voltage cables shall then be reinstalled on the rectifier. For operation, refer to the special directions for operation which are furnished with the apparatus.



OPERATING INSTRUCTIONS

FOREWORD

These directions are prepared to assist you in obtaining the utmost from your equipment and it is urged that they be read carefully and thoroughly before placing the equipment in operation. To do so will insure obtaining that quality of results which this equipment is capable of producing.

DESCRIPTION

The following description is presented to enable you to understand the purpose of the various controls and devices as well as their location and manipulation.

CONTROL STAND

THE CIRCUIT BREAKER is located on the left side of the control stand. As the name implies, it is a device for the protection of the equipment in case of excessive overload. It functions like any tumbler type switch. When the lever is in the OFF position, all power is disconnected, irrespective of the position of the line switch. Normally, the circuit breaker should be ON and the control stand operated as though the circuit breaker were not there. In case of overload, the circuit breaker automatically opens, the lever assuming a position half-way between ON and OFF. To reset, the lever is first pushed to the OFF position as far as it will go and then to the ON position.

THE LINE SWITCH is a combination three-position switch and serves not only to connect the equipment to the power supply but also as an x-ray safety switch.

When it is in the OFF position, the equipment is disconnected from the power supply. Moving the switch to the ON position lights the filaments of the kenotrons and x-ray tube, and permits the operator to make the preliminary settings of the controls without danger of accidental exposure. The switch should be moved to the X-RAY position just prior to making the exposure. The normal function of the X-RAY position is that of a safety switch which must be closed just prior to the x-ray exposure. The x-ray exposure is usually made through the medium of the Synchronous Timer and only if the line switch is on X-RAY. For therapy work placing the switch in the X-RAY position starts the exposure. The exposure will remain on as long as line switch is in the X-RAY position. The switch should be placed in the OFF position after an exposure has been completed unless another exposure is to be made immediately. This conserves the kenetron and x-ray tube filaments.

An interlock with the X-RAY position of the line switch is provided so that the rotor of the rotating anode tube (if one is used) remains stationary until this switch is moved to the X-RAY position.

THE VOLTAGE COMPENSATOR is a device used to enable the operator to compensate for changes in line voltage without changing the other controls. It has ten positions, each representing a change of approximately 3.4 volts in line voltage.

The actual voltage obtainable from a given power source usually varies from time to time during the day. Unless there is compensation for this variation, other changes in control settings must be made to obtain the anticipated end result. This is particularly true of the kilovolt selector and filament control since the proper values of kvp and milliamperage are essential for the best results.

After closing the line switch, the first step in the operation of the equipment is to observe the reading of the VOLTMETER. With the voltage compensator correctly adjusted, the needle of the voltmeter should read exactly on or slightly to the right of the calibration line on the meter scale. If the meter reads voltage high or voltage low the line x-ray switch should be turned to the OFF position, and the voltage compensator turned to lower or raise the voltage as required.

THE KILOVOLT SELECTOR, as its name implies, is a means by which the operator can control the kilovoltage impressed across the tube and thus control the penetration of the x-radiation. This control has 52 positions, each representing a definite kilovoltage across the tube for a given milliamperage on a given power service. A number of calibration charts are included in these instructions. The proper one to be used will be selected at the time installation is made and thereafter only that chart should be used.

This chart shows that for a given setting of the kilovolt selector, the kilovoltage decreases with an increased milliamperage. Conversely, for a given kvp a higher kilovolt selector setting is required if the milliamperage is increased. Therefore, it is important that the kilovolt selector setting be made on the basis of the milliamperage to be used.

THE FILAMENT CONTROL provides control of milliamperage by regulating the filament current in the x-ray tube. Turning the control in a clockwise direction increases the temperature of the filament in the x-ray tube, and thus the milliamperage, while turning it in a counterclockwise direction decreases the milliamperage.

THE TECHNIC SELECTOR is a combination rheostat, kenotron filament temperature adjuster, milliammeter scale selector, x-ray tube filament selector, and timer selector.

For fluoroscopy and therapy, it is important to provide resistance in the primary of the step-up transformer. This resistance is automatically added when the technic selector is in the FLUOROSCOPY or THERAPY position.

As a kenotron filament temperature selector, it conserves kenotron life by making it unnecessary to burn kenotrons at a higher temperature than is required for the technic being used. When the technic selector is in the position marked RADIOGRAPHY LARGE FOCUS the kenotron filaments are energized to give 200 ma emission. When the technic selector is placed on RADIOGRAPHY SMALL FOCUS the kenotron filaments are energized to give 50 ma emission. On fluoroscopy and therapy the kenotron

filaments are energized for an emission of 10 ma. When the rotating anode tube is used, the technic selector is modified to give 200 ma emission on both the RADIOGRAPHY LARGE FOCUS and RADIOGRAPHY SMALL FOCUS positions.

The technic selector changes the connections to the milliammeter so that the 0-50 scale is read for RADIOGRAPHY SMALL FOCUS, FLUOROSCOPY, and THERAPY technics. The 0-250 scale is read for RADIOGRAPHY LARGE FOCUS. When the rotating anode tube is used on the installation, the technic selector is changed so that the 0-250 scale is read for both RADIOGRAPHY LARGE FOCUS and RADIOGRAPHY SMALL FOCUS. This is to take care of the 200 ma rating on the small focus of the CRT tube. Also when the rotating anode tube is used, the 0-50 scale is read for fluoroscopic and therapy technics.

When the technic selector is placed on FLUOROSCOPY the timing of the exposure is determined by the length of time that the foot switch is held down. The light on the timer dial is automatically extinguished when the foot switch is selected so that the light will not interfere with fluoroscopic examinations when the control stand is located in the same room as the diagnostic table.

When the technic selector is in the THERAPY position the magnetic switch is automatically started and the treatment is controlled entirely by the line switch. Treatment begins when the switch is on X-RAY and terminates when removed from this position.

THE MILLIAMMETER indicates the tube current in the x-ray tube circuit. Ordinarily the milliammeter is used to measure the x-ray tube current of relatively low value, while for relatively high milliamperage exposures where the time of exposure is limited by the x-ray tube, the ammeter is used to permit pre-setting the filament to produce a tube current which can be calculated through the use of filament increment charts supplied with most x-ray tubes. The milliammeter has two scales, one reading from 0-250 milliamperes and one reading from 0-50 milliamperes and the particular scale to read is determined by the position of the technic selector.

When the technic selector is on THERAPY, FLUOROSCOPY, or RADIOGRAPHY SMALL FOCUS, the 0-50 scale should be read; when the technic selector is on RADIOGRAPHY LARGE FOCUS the 0-250 scale should be read. When a rotating anode tube is used the 0-250 scale is read for both RADIOGRAPHY LARGE FOCUS and RADIOGRAPHY SMALL FOCUS, and the 0-50 scale is read for FLUOROSCOPY and THERAPY technics.

THE AMMETER indicates the current flowing in the filament circuit of the x-ray tube in terms of amperes. It is used to pre-set the filament current to a value that will produce an x-ray tube current of relatively high milliamperage value. This prolongs the life of the x-ray tube by eliminating the necessity for testing the x-ray tube before the exposure is made. The use of the filament increment chart is explained in the instructions which accompany most x-ray tubes.

THE OIL IMMERSSED HIGH-VOLTAGE SWITCH located in the transformer tank, permits selection of either of two x-ray tubes. The switching operation is controlled remotely by the X-RAY TUBE SELECTOR mounted on the control panel. As the two x-ray tubes are generally used for radiography and fluoroscopy, the x-ray tube selector has indicating lights for convenience labelled RADIOGRAPHY and FLUOROSCOPY. When the indicator on the x-ray tube selector is turned to either position, the tube indicated is connected and the corresponding signal should light.

THE SYNCHRONOUS TIMER is a device for automatically timing the x-ray exposure. The dial is calibrated from 1/20 second to 20 seconds. Except for the first half

second which is calibrated in increments of $1/20$ second, the dial calibration is in increments of $1/4$ second. All are mechanically indexed to facilitate setting the timer for the desired exposure.

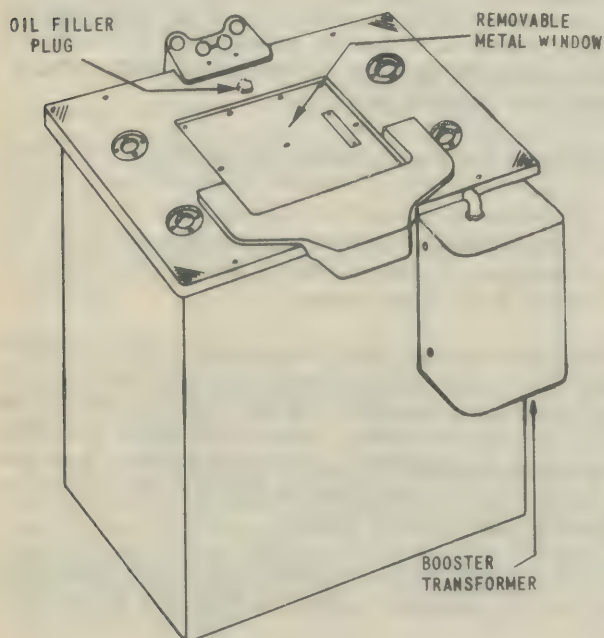
To select the time interval turn the INDEX KNOB so that the time interval desired is immediately below the illuminated notch on top of the timer dial.

When the technic selector is placed on FLUOROSCOPY, the timer is properly connected for a fluoroscopic exposure. These connections have been described in the section on technic selector. As with any timer of this class, a slight variation in timing value above or below the rated time value is permissible. The Synchronous Timer may be used for timing x-ray exposures when using the tube currents up to the rated output of the KX-11.

THE IMPULSE TIMER is an optional auxiliary device which may be used with the KX-11 to provide the most perfect control of exposure time obtainable. It is designed so that the x-ray exposure is begun and terminated at the zero point of the alternating current wave. Thus, in so far as the radiograph is concerned, it times with absolute accuracy. This principle, by means of which precision timing is obtained, eliminates the need of an auxiliary contactor and permits the handling of a primary current of greater magnitude than is required in any x-ray apparatus available today. When operated on a 60 cycle power supply, it has a timing range from $1/60$ second to $1/5$ second in increments of $1/120$ second. On a 50 cycle power supply, it has a timing range from $1/50$ second to $24/100$ second in increments of $1/100$ second. Its use is recommended for technics requiring more than 100 ma.

Provisions are available for mounting the Synchronous Timer and Impulse Timer in a twin housing which is interchangeable on a control stand equipped to accommodate The Synchronous Timer only.

THE KENOTRON INDICATOR is mounted on the x-ray tube selector panel and is arranged so that if the filament of any kenotron is not energized, the indicator light will show red.



The KX-11 control is provided with a FOOT SWITCH and a HAND SWITCH for controlling the Synchronous Timer. Either of these switches may be chosen by means of the Timer SWITCH SELECTOR located on the control stand. The exposure can be made only by the switch indicated on the timer switch selector.

THE HIGH-VOLTAGE TRANSFORMER AND RECTIFIER UNIT

No particular description of the high voltage transformer and rectifier unit is necessary as this unit does not require attention in the normal operation of the equipment. It contains a high-voltage transformer, three kenotron filament transformers for lighting the filaments of the four kenotrons, four type KR-6 kenotrons, two x-ray tube filament transformers, and a high voltage switch all immersed in oil in a single

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welded sheet steel tank. The high-voltage leads are brought out through shock-proof plug-in type receptacles and cables. A booster transformer, which operates in conjunction with the high-voltage transformer, is mounted on the side of the transformer tank.

The rectifier is a four kenotron full-wave type, delivering a pulsating direct current to the x-ray tube.

Access to the interior of the transformer tank for inspection or replacement of the kenotrons is through the metal window in the top of the transformer tank. (see section on Maintenance)

RATING

The Model KX-11 X-Ray Unit employs a full-wave four kenotron circuit and is rated for radiography, fluoroscopy, and superficial therapy as follows:

Radiography: 200 ma, 100kvp for .20 sec.
20 ma, 110kvp for 30 sec.

Fluoroscopy and Therapy:

5 ma, 100kvp continuous
for 4 hours

The above ratings apply to altitudes up to 8000 feet, average humidity not exceeding 95 per cent.

These ratings are subject to limitations of both the x-ray tube and length of shockproof, high-voltage cable. The maximum rating of the x-ray tube will be found in the rating chart supplied with each tube. The maximum permissible length of cable that may be used in conjunction with the Model KX-11 X-Ray Unit is 40 feet.

OPERATION

Actual operation of the Model KX-11 presupposes that certain preliminary steps have been accomplished. These include positioning of the patient, the x-ray tube, cassette, and preparation of any devices that may be involved. Having made these preliminary preparations, you are ready to begin operation.

In setting the technic selector, voltage compensator, and kilovolt selector, you will hear a definite "click" or feel a snapping into place. When seated properly, these controls require more effort to move them forward or backward than when they are between two adjacent positions. DO NOT leave the control halfway between buttons.

These instructions have been prepared in a step-by-step form so that the operation of the unit may follow the proper sequence. The steps in operation appear first, followed by a detailed explanation of each procedure.

OPERATION FOR RADIOGRAPHY

1. Check the position of the circuit breaker to make certain that it is in the ON position.

The circuit breaker controls the power to the control stand. After the circuit breaker is in the ON position, the power supply is controlled by the line switch. Normally, the circuit breaker should be in the ON position and the control stand operated as if the circuit breaker were not there. However, in the event that the circuit breaker has previously been opened as a result of overload, the lever of the

circuit breaker will be found in a position midway between OFF and ON. In this event, push the lever to the OFF position as far as it will go and then move it to the ON position. Thereafter the control stand should be operated as if the circuit breaker were not there.

2. Set the technic selector.

This setting should be made before closing the line switch to avoid needless burning of the kenotron and Coolidge tube filaments. If the large focus of the tube is to be used, set on RADIOGRAPHY LARGE FOCUS. If the small focus is to be used, set on RADIOGRAPHY SMALL FOCUS. On these settings, the kenotron filament currents are adjusted to give the proper emission. The technic selector also makes connection to the milliammeter so that the 0-250 scale should be read on the large focus and the 0-50 scale should be read on the small focus.

3. Adjust the kilovolt selector.

This adjustment should be made prior to closing the line switch to avoid needless operation of the equipment. The setting of the kilovolt selector determining the voltage across the x-ray tube. The actual kilovoltage across the tube for any given setting of the kilovolt selector depends upon the milliamperage; the proper kilovolt selector setting to produce the desired kvp at a given milliamperage, may be readily determined from the calibration chart accompanying these instructions. The proper chart to use will be designated at the time installation is made.

4. Set the Synchronous Timer.

The Synchronous Timer will automatically start the exposure and terminate it at the end of the time for which the timer has been set.

5. Place the line switch in the ON position.

With the line switch ON, the filaments of all four kenotrons and the filament of the x-ray tube should be lighted. The ammeter and voltmeter should read.

6. Note the reading of the voltmeter and readjust the voltage compensator if the voltmeter does not read correctly.

The calibration charts provided are correct only when the voltmeter needle is on the line in the center of the meter. Always open the line switch before changing the position of the voltage compensator. If this control is operated with the line x-ray switch closed, sparking will occur at the contacts and this will necessitate early service. The voltage compensator should be set to the position in which the voltmeter needle reads on or slightly to the right of the index line.

7. Select the tube to be used.

Turn the control knob of the x-ray tube selector toward the indicating light of the desired tube until the indicator on the control knob lines up with the position RADIOGRAPHY or FLUOROSCOPY; the high-voltage switch will automatically connect the rectifier to this tube. The indicating lamp which is glowing and the corresponding nameplate identification show which tube is connected to the rectifier.

8. Adjust the filament control to give the desired filament current as indicated on the ammeter.

The filament control regulates the tube current by controlling the filament temperatures. Regardless of the tube or technic used, the filament characteristics should be known so that when the x-ray exposure is made, no damage to the tube will result.

IMPORTANT: When measuring the baseline current for the x-ray tube filament increment curves, be sure to read the lower scale of the milliammeter for the small focus and the upper scale for the large focus. For high milliamperage technics, the proper operation of most tubes demands that the filament current be pre-set to rather close limits. The instructions concerning the operation of the particular tube being used should be fully understood before proceeding further in the operation of the equipment.

NOTE: If the CRT tube is used, the 0-250 scale should be read for both large and small focus.

9. Move the line switch to the X-RAY position.

The x-ray exposure cannot be made until the line switch is placed in the X-RAY position. The actual exposure is not made until the exposure timer is operated. This switch should be left on X-RAY only long enough to make the exposure.

NOTE: Closing this switch also starts the rotor of the rotating anode tube, if it is included in the installation.

10. Place the timer switch selector on HAND SWITCH and operate the timer.

If the Synchronous Timer is being used, the exposure is started by pressing on the hand switch until the exposure is terminated. This operation causes the timer to begin functioning, and starts the x-ray exposure. The exposure is automatically terminated at the end of the time interval for which the timer was set.

11. Place the line switch in the OFF position.

This removes all power from the control stand.

OPERATION FOR FLUOROSCOPY

1. If a Fluorographic Screen Unit and Dual Control are part of the installation, remove the connecting cord from the fluorographic screen unit and replace the fluorographic screen unit with the regular fluoroscopic screen.

This permits operation of the x-ray unit as if the Dual Control were not there.

2. Check the position of the circuit breaker to make certain that it is in the ON position.

The circuit breaker controls the power to the control stand. After the circuit breaker is in the ON position, the power supply is controlled by the line switch. Normally, the circuit breaker should be in the ON position and the control stand operated as if the circuit breaker were not there. However, in the event that the circuit breaker has previously been opened as a result of overload, the lever of the circuit breaker will be found in a position midway between OFF and ON. In this event, push the lever to the OFF position as far as it will go and then move it to ON position. Thereafter the control stand should be operated as if the circuit breaker were not there.

3. Set the technic selector in the position marked FLUOROSCOPY.

The proper position of the pointer on the technic selector is the middle of the word FLUOROSCOPY. When set properly, a definite click will be noticed. This position places resistance in the primary circuit of the high-voltage transformer, changes the connections to the milliammeter so that the 0-50 scale should be read, and disconnects the timing mechanism of the timer so that the exposure continues as long as the foot switch is held down.

4. Adjust the kilovolt selector.

The position of the kilovolt selector determines the voltage across the x-ray tube, which is dependent upon the tube current used. The proper setting to obtain the desired kvp can be determined from the calibration chart for fluoroscopy and therapy accompanying these instructions.

5. Place the line switch in the ON position.

In this position, the filaments of the kenotrons and x-ray tube should be lighted and the ammeter and voltmeter should read.

6. Note the reading of the voltmeter and adjust the voltage compensator if necessary.

Proper operation of the equipment is dependent upon the correct setting of the voltage compensator. Always open the line switch when making adjustment of the voltage compensator. If this control is operated with the line switch closed arcing at the contacts will occur and this will necessitate early service. When the voltage compensator is properly adjusted, the compensator voltmeter needle should read on or slightly to the right of the index mark on the voltmeter.

7. Select the tube to be used.

Turn the control knob of the x-ray tube selector toward the indicating light of the desired tube until the indicator on the control knob lines up with the position RADIOGRAPHY or FLUOROSCOPY; the high-voltage switch will automatically connect the rectifier to this tube. The indicating lamp which is glowing and the corresponding nameplate identification show which tube is connected to the rectifier.

8. Adjust the filament control for the desired filament current.

For low milliamperage technics, such as are used in fluoroscopy, the filament control should be set to give the desired tube current irrespective of the ammeter reading; the filament control should be initially adjusted to provide a filament current at least approximately that required for fluoroscopy. Unless this is done, there is a possibility that the filament may have been left on a high tube current setting, which may result in damage to the tube.

9. Place the line switch in the X-RAY position.

The x-ray exposure cannot be made until this switch is placed in the X-RAY position. This switch should be closed just before the exposure is made and opened immediately after the exposure.

10. Place the timer switch selector on FOOT SWITCH and step on the foot switch of the Synchronous Timer.

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When the technic selector is placed on FLUOROSCOPY, the x-ray exposure remains on as long as the foot switch is held down. When the timer selector is placed on FOOT SWITCH the timer light is turned out so that it will not interfere with the fluoroscopic examination.

11. Readjust the filament control for the proper milliamperage.

Immediately on beginning the exposure, note the reading of the milliammeter and correct the setting of the filament control if necessary to produce the milliamperage desired.

12. Remove the foot from the foot switch to terminate the exposure.

This operation automatically terminates the exposure.

13. Move the line switch to the OFF position.

This operation removes all power from the control.

OPERATION FOR SUPERFICIAL THERAPY

When the model KX-11 is used for superficial therapy, control of the x-ray exposure is obtained through operation of the line switch. The KX-11 may be operated up to 5 ma, 100 kvp for four continuous hours.

1. If a Fluorographic Screen Unit and Dual Control are part of the installation, remove the connecting cord from the fluorographic screen unit.

This permits operation of the x-ray unit as if the Dual Control were not there.

2. Check the position of the circuit breaker to make certain that it is in the ON position.

The circuit breaker controls the power to the control stand. After the circuit breaker is in the ON position, the power supply is controlled by the line switch. Normally, the circuit breaker should be ON and the control stand operated as if the circuit breaker were not there. However, in the event that the circuit breaker has previously been opened as a result of overload, the lever of the circuit breaker will be found in a position midway between OFF and ON. In this event, push the lever to the OFF position as far as it will go and then move it to the ON position. Thereafter the control stand should be operated as if the circuit breaker were not there.

3. Set the technic selector on the position marked THERAPY.

The proper position for the handle of the technic selector is as far in the clockwise direction as it will go. Setting the technic selector on THERAPY places resistance in the primary of the high-voltage transformer, changes the electrical connection to the milliammeter so that the 0-50 scale is read, and allows the x-ray exposure to be controlled by the line switch.

4. Adjust the kilovolt selector.

The position of the kilovolt selector determines the voltage across the x-ray tube; the kilovoltage is dependent upon the tube current. The proper setting to obtain the desired output can be determined from the calibration chart for fluoroscopy and superficial therapy which is included in these directions.

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5. Place the line switch in the ON position.

In this position, the filaments of the kenotrons and x-ray tube should be lighted and the ammeter and voltmeter should read.

6. Note the reading of the voltmeter and adjust the voltage compensator if necessary.

Proper operation of the equipment is dependent upon the correct setting of the voltage compensator. Always open the line switch when making adjustment of the voltage compensator. If this control is operated with the line switch closed, arcing at the contacts will occur and this will necessitate early service. When the voltage compensator control is properly adjusted, the voltmeter needle should read on or slightly to the right of the index mark on the voltmeter.

7. Select the tube to be used.

Turn the control knob of the x-ray tube selector toward the indicating light of the desired tube until the indicator on the control knob lines up with the position RADIOGRAPHY or FLUOROSCOPY; the high-voltage switch will automatically connect the rectifier to this tube. The indicating lamp which is glowing and the corresponding nameplate identification show which tube is connected to the rectifier.

8. Adjust the filament control for the desired filament current.

For low milliamperage technics such as are used in superficial therapy, the filament control should be set to give the desired tube current irrespective of the ammeter reading; the filament control should be initially adjusted to provide a filament current at least approximately that which is required. Unless this is done, there is a possibility that the filament may have been left on a high tube current setting from a previous exposure, which may result in damage to the x-ray tube.

9. Place the line switch to the X-RAY position.

Placing the line switch in the X-RAY position starts the exposure and it will remain on as long as the line switch is in the X-RAY position.

10. Readjust the filament control until the milliamperage is obtained.

11. Move the line switch to the OFF position.

This removes all power from the control stand and terminates the exposure.

CALIBRATION CHARTS

One set of calibration charts with a suitable frame is supplied with these directions. The set of charts applied to installations using cables not longer than 25 feet each. When the length per cable is greater than 25 feet, the same charts apply except that the maximum kilovoltage is reduced to 90 kvp.

The choice of correct calibration depends on the characteristics of power supply and will be made by the representative in charge of the installation. It is suggested that the selected chart be framed and conveniently hung on the wall.

G-E FLUOROGRAPHIC UNIT

The G-E Fluorographic Unit makes available to users of the model KX-11 X-Ray Unit with the model 33, 36, or 39 X-Ray Table, a very important advance in the

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widely accepted procedure for the fluoroscopic study of the internal organs and foreign objects, -- the radiographic recording of the fluoroscopic image within a brief time after fluoroscopic visualization.

DUAL CONTROL UNIT

The Dual Control is designed for mounting in the control stand of the x-ray generating unit. It consists essentially of an auxiliary filament control and automatic relay system connected electrically with a switch incorporated in the fluorographic Screen Unit. The Dual Control is arranged and connected so that the generator setting can be quickly changed from radiography to fluoroscopy, and vice versa through the simple expedient of shifting the cassette-shifting knob on the Fluorographic Screen Unit.

The functions performed by the Dual Control with the cassette-shifting knob of the Fluorographic Screen Unit in fluoroscopic and radiographic positions, and with the technic selector on FLUOROSCOPY, are tabulated on next page.

The filament control is the only adjustable control on the Dual Control. The control knob passes through an opening on the front panel of the x-ray control stand and is used for pre-setting the x-ray generator for the desired milliamperage output in fluoroscopy.

FLUOROGRAPHIC SCREEN UNIT

The Fluorographic Screen Unit and the regular fluoroscopic screen supplied with the table are interchangeable.

The Fluorographic Screen Unit consists essentially of a type B Patterson Fluoroscopic screen, cassette tunnel, cassette-shifting knob, switch contacts interconnected with the Dual Control by means of a connecting cord, wafer grid, and two compression cones. Detailed description of the component members of this unit are described in separate directions.

Position of Cassette Shift- ing Knob	X-Ray Tube Focal Spot	Protective Resistance	Milliam- meter Scale	Timing Unit Magnetic Switch	Kenotron Emission Adjusted for
Double focus tube under the table					
Fluoroscopic	Small	In circuit	0-50	Timing unit disconnect- ed. Magnetic switch in circuit.	Fluoroscopic intensity
Radiographic	Large	Shorted	0-250	Both con- nected in circuit.	200 ma
Single focus tube under the table					
Fluoroscopic	Single Focus Used	In circuit	0-50	Timing unit disconnect- ed. Magnetic switch in circuit.	Fluoroscopic intensity

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Position Cassette shift- ing Knob	X-Ray Tube Focal Spot	Protective Resistance	Milliam- meter Scale	Timing Unit Magnetic Switch	Kenotron Emission Adjusted for
Radiographic		Shorted	0-250	Both con- nected in circuit	200 ma

The cassette-shifting knob serves to shift manually the cassette into the radiographic position underneath the fluoroscopic screen and to return the cassette back into the fluoroscopic position, that is, into the protected tunnel.

When the cassette is shifted into the radiographic position (below the fluoroscopic screen), the switch contacts in the Fluorographic Screen Unit close, energizing the relays of the Dual Control and thus setting the generator for radiographic exposure. Shifting the cassette into the fluoroscopic position (into the protected tunnel) causes opening of the switch contacts, thus restoring the generator setting for fluoroscopic duty.

A connecting cord is plugged into the Fluorographic Screen Unit in order to effect electrical connections between the contacts contained there and in the Dual Control.

SETTING GENERATOR OUTPUT FOR FLUOROGRAPHIC WORK

In making generator settings, the fluoroscopic kilovoltage depends upon the milliamperage and the kilovoltage employed for radiographic exposure. The higher the milliamperage and the kilovoltage used in radiography, the higher will be the fluoroscopic kilovoltage, even though a series resistance is introduced into the primary circuit when the generator output is switched to fluoroscopy. Since the focal spot-film distance in the fluorographic procedure is relatively short, the use of intermediate milliamperage and kilovoltage in radiography is recommended.

SETTING GENERATOR FOR RADIOGRAPHY USING DOUBLE-FOCUS TUBE UNDER THE TABLE

1. *Set the Technic selector on RADIOGRAPHY.*

This permits pre-setting the generator for the radiographic exposure.

2. *Place the line switch in the ON position.*

With the line switch in the ON position, the filaments of the kenotrons and the x-ray tube are lighted. The ammeter and the compensator voltmeter should read.

3. *Adjust the voltage compensator.*

Correct calibration can be assured only if the voltage compensator is adjusted so that the compensator voltmeter needle is on the line. The line switch should be turned to the OFF position before making adjustment of the voltage compensator in order to avoid burning of the contacts and preclude early servicing.

4. *Set the x-ray tube selector on FLUOROSCOPY.*

This connects the x-ray tube under the table to the rectifier.

5. *Set the timer switch selector on the control stand on HAND SWITCH.*

The hand switch is used for making the check exposures.

6. *Adjust the generator for radiography.*

Set the kilovolt selector, the regular filament control of the x-ray unit, and the Synchronous Timer for the technic factors to be employed. These settings are made as if there were no fluorographic unit.

7. *If a trial exposure is to be made place the line switch in the X-RAY position.*

The trial exposure cannot be made until the line switch is placed in the X-RAY position. Depress the TIMER button of the hand switch and read the high scale of the milliammeter. Do not exceed the rating of the x-ray tube during the trial exposure.

Omit this step if the filament control is pre-set for the desired milliamperage in accordance with the filament increment chart.

8. *Turn the line switch back to the ON position.*

This step prevents any possibility of accidental exposure.

SETTING GENERATOR FOR FLUOROSCOPY
USING DOUBLE-FOCUS TUBE UNDER THE TABLE

1. *Move the cassette shifting knob into the fluoroscopic position; that is, as far away from the fluoroscopic screen as the knob will go.*

This operation opens the switch contacts in the Fluorographic Screen Unit and permits setting the generator for fluoroscopy.

2. *Turn the technic selector to the FLUOROSCOPY position.*

This operation connects the small focal spot of the tube, adds series resistance in the primary of the high-voltage transformer, changes the milliammeter scale to LOW, lowers temperature of the kenotron filaments, and disconnects the timing mechanism of the Synchronous Timer.

3. *Place the line switch in the X-RAY position and make a trial exposure.*

The trial exposure cannot be made until the line switch is placed in the X-RAY position. Depress the TIMER button of the hand switch, and read the low scale of the milliammeter.

4. *Set the filament control of the Dual Control to secure the desired milliamperage for fluoroscopy.*

When the technic selector is in the FLUOROSCOPY position, both the regular filament control and the auxiliary control are placed in series. Since the regular filament control has already been set for radiography, the desired filament current in fluoroscopy should be obtained by adjusting the filament control of the Dual Control.

5. *Turn the line switch back to the ON position.*

This step prevents any possibility of accidental exposure.

SETTING GENERATOR FOR RADIOGRAPHY
USING SINGLE FOCUS TUBE UNDER THE TABLE

1. *Move the cassette shifting knob toward the fluoroscopic screen as far as it will go; that is, place the knob into the position which it will occupy during radiography.*

This operation closes the switch contacts within the Fluorographic Screen Unit and permits setting the generator for radiography.

2. *Turn the technic selector in the FLUOROSCOPY position.*

This permits pre-setting the generator for the radiographic exposure.

3. *Place the line switch in the ON position.*

With the line switch in the ON position, the filaments of the kenotrons and the x-ray tube are lighted. The ammeter and the compensator voltmeter should read.

4. *Adjust the voltage compensator.*

Correct calibration can be assured only if the voltage compensator is adjusted so that the compensator voltmeter needle is on the line. The line switch should be turned to the OFF position before making adjustment of the voltage compensator in order to avoid burning of the contacts and preclude early servicing.

5. *Set the x-ray tube selector on FLUOROSCOPY.*

This connects the x-ray tube under the table to the rectifier.

6. *Set the timer switch selector on the control stand to the HAND SWITCH position. The hand switch is used for making the check exposures.*

7. *Adjust the generator for radiography.*

Set the kilovolt selector, the regular filament control of the x-ray unit, and the Synchronous Timer for the technic factors to be employed. These settings are made as if there were no fluorographic unit.

8. *If a trial exposure is to be made place the line switch in the X-RAY Position.*

The trial exposure cannot be made until the line switch is placed in the X-RAY position. Depress the TIMER button of the hand switch and read the high scale of the milliammeter. Do not exceed the rating of the x-ray tube during the trial exposure.

Omit this step if the filament control is pre-set for the desired milliamperage in accordance with the filament increment chart.

9. *Turn the line switch back to the ON position.*

This step prevents any possibility of accidental exposure.

SETTING GENERATOR FOR FLUOROSCOPY
USING SINGLE FOCUS TUBE UNDER THE TABLE

1. *Move the cassette shifting knob away from the fluoroscopic screen as far as*

it will go; that is, place the knob in the position it will occupy during fluoroscopy.

This operation opens the switch contacts in the Fluorographic Screen Unit, and permits setting the generator for fluoroscopy.

- 2. Place the line switch in the X-RAY position and make a trial exposure.*

The trial exposure cannot be made until the line switch is placed in the X-RAY position. Depress the TIMER button of the hand switch and read the low scale of the milliammeter.

- 3. Set the filament control of the Dual Control to secure the desired milliamperage for fluoroscopy.*

When the technic selector is in the FLUOROSCOPY position, and the cassette shifting knob is away from the fluoroscopic screen as far as it will go, both the regular filament control and the auxiliary filament control are placed in series. Since the regular filament control had already been set for radiography, the desired filament current for fluoroscopy should be obtained by adjusting the filament control of the Dual Control.

- 4. Turn the line switch back to the ON position.*

This step prevents any possibility of accidental exposure.

OPERATION OF FLUOROGRAPHIC UNIT USING SINGLE FOCUS OR DOUBLE FOCUS TUBE UNDER THE TABLE

Before beginning operation of the Fluorographic Unit, it is assumed that the generator has been properly adjusted for radiography and fluoroscopy as described above. Position the patient; if deemed desirable, the wafer grid and one of the compression cones may be used.

- 1. Insert a cassette in the Fluorographic Screen Unit.*

Move the cassette-shifting knob away from the fluoroscopic screen as far as it will go; that is, place the knob into the position it will occupy during fluoroscopy.

- 2. Check to ascertain that the x-ray tube selector and the technic selector are in the FLUOROSCOPY position.*

The x-ray tube selector and the technic selector should be left in the FLUOROSCOPY position throughout the duration of the fluorographic series.

- 3. Set the timer switch selector to the FOOT SWITCH position.*

This allows the exposure to be controlled by the foot switch at the table.

- 4. Turn the line switch to the X-RAY position.*

The x-ray exposure cannot be made until the line switch is placed in the X-RAY position. It should be closed just before the exposure is made.

- 5. Step on the foot switch.*

The x-rays of fluoroscopic intensity will be made when the foot switch is pressed. Fluoroscopic examination can now be made.

6. Release the foot switch.

The fluoroscopic exposure terminates when the foot switch is released.

7. Place the cassette-shifting knob in the RADIOGRAPHIC position.

To do this move the cassette-shifting knob until the cassette is squarely below the fluoroscopic screen. Shifting of the knob automatically changes the setting of the x-ray generator from fluoroscopy to radiography as determined by the preliminary adjustments of the generator.

8. Step on the foot switch.

Stepping on the foot switch operates the Synchronous Timer, which automatically starts the exposure and terminates it at the end of the time for which it has been set.

9. Release the foot switch after the exposure is completed.

This step completes the first fluoroscopic and radiographic series. Do not step on the foot switch a second time, because this will cause a second exposure and thus will ruin the film.

10. Remove the cassette from the Fluorographic Screen Unit.

Pull the cassette-shifting knob toward the tunnel opening and remove the cassette. Place a new cassette in the tunnel and put it into the fluoroscopic position. This restores the fluoroscopic setting of the generator. The fluoroscopic examination may now be resumed.

11. Unless the fluorographic series is to be continued, move the line switch to the off position.

This de-energizes the control stand.

12. Restore the equipment for regular work.

Pull the connecting cord from the Fluorographic Screen Unit and replace with the regular fluoroscopic screen.

IMPORTANT: Removal of the connecting cord is necessary upon completion of the fluorographic series. X-rays of radiographic intensity will be obtained in all positions of the technic selector on energizing the equipment, if the cassette shifting knob is in the radiographic position and the connecting cord is not removed.

X-RAY PROTECTION

The Model KX-11 X-Ray Unit in itself produces no x-radiation against which it is necessary to take special precaution. It is, however, a part of an installation producing radiation which, if improperly used, may be dangerous. No practical design of equipment can avoid the possibility of authorized or unauthorized persons carelessly or unwisely exposing themselves to direct radiation, or to secondary radiation given off from the patient, nor can the design of the equipment compel the operator or his assistant to take adequate precautions.

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It is assumed that all persons authorized to use the equipment are cognizant of the danger of excessive exposure to x-radiation, and the equipment is sold with the understanding that the General Electric X-Ray Corporation or its agents will assume no responsibility for injury from exposure to x-radiation as a result of carelessness, ignorance or accident.

Various protective materials and devices are available. It is urged that such materials or devices be used whenever and wherever possible.

When using the Fluorographic Unit the usual precautions for protecting the operator against x-radiation should be employed. Briefly, this consists of keeping the diaphragm control turned down so that primary radiation can be kept within the confines of the fluoroscopic screen, wearing the usual protective material such as lead rubber gloves, lead rubber apron, etc.

It is further urged that everyone having anything to do with the work of the x-ray department be fully acquainted with the recommendations of the National Bureau of Standards and the International Roentgen-Ray Committee on X-Ray Protection, and take adequate steps to insure their own protection against injury.

MAINTENANCE

The KX-11 requires little maintenance. Check the oil level through the opening for the Oil Filler Plug, (located under the transformer cover) about once a year. The oil level as measured from the oil surface to the under side of the transformer cover when the oil is at room temperature should be as follows:

60 - 80 degrees F.	- 7/8 inch
81 - 100 degrees F.	- 3/4 inch
101 - 105 degrees F.	- 5/8 inch

Additional transil transformer oil, if required, should be obtained. Every effort should be made to prevent contamination of the oil.

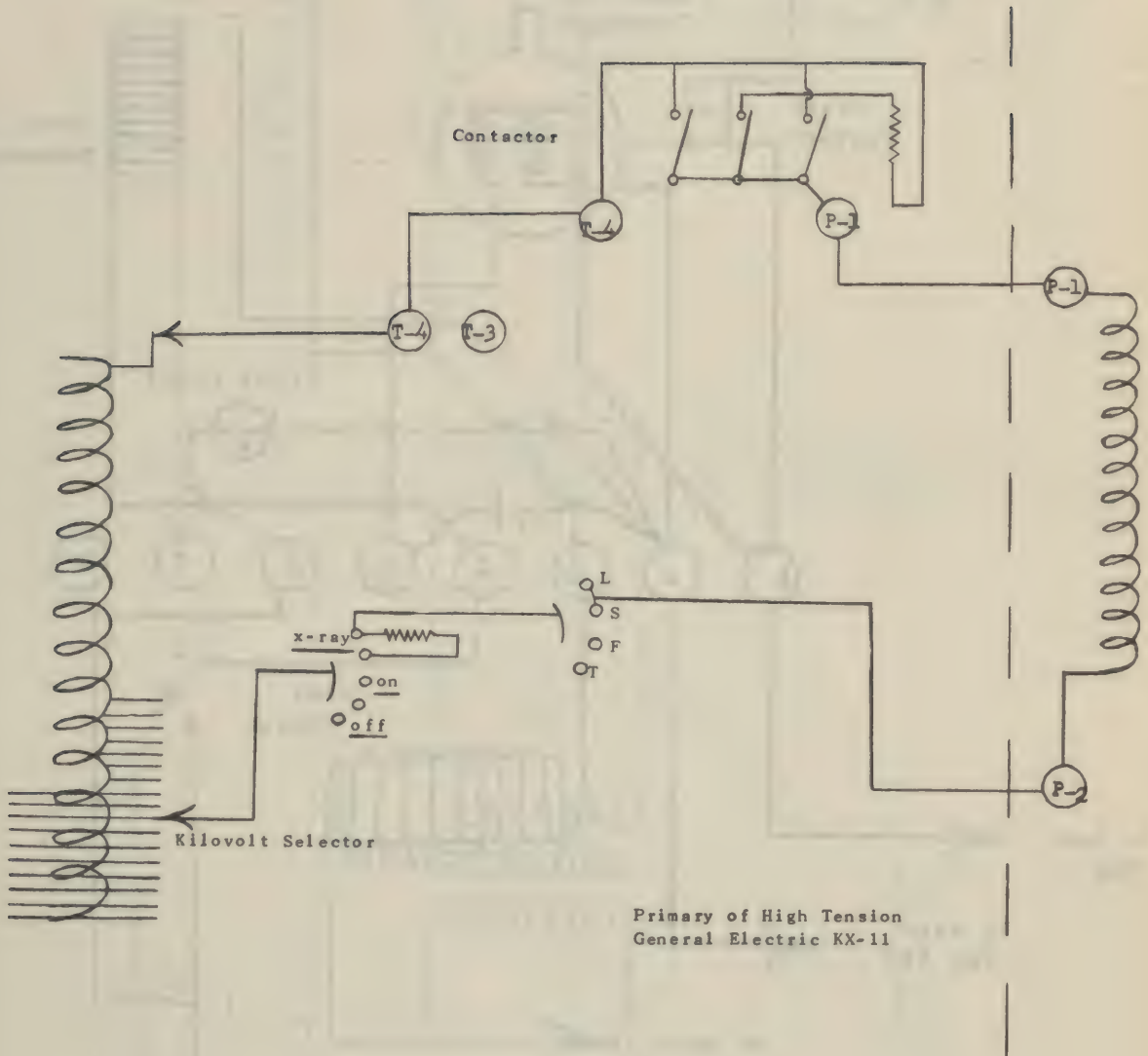
The proper functioning of the kenotron rectifier requires that the filaments of the four kenotrons be lighted. The kenotron indicator should not glow when all of the kenotron filaments are lighted, regardless of the position of the technic selector. If a kenotron filament is burned out, the kenotron indicator will glow. Under normal conditions, this indicator may flash during switching operation of the line switch and the technic selector, but the glow should not persist. If the indicator glow is continuous, the kenotrons should be inspected and the burned-out kenotron replaced.

When replacing one or more of the kenotrons, slight differences in filament current between the old and new kenotron may cause a persistent glow of the kenotron indicator in spite of the fact that the kenotrons are operating satisfactorily. Under these conditions, adjustment for elimination of the persistent glow can be made by resetting the connections of the brass link between terminal K-3, and any one of the terminals T-1, T-2, T-3, or T-4, on the terminal board of the kenotron indicator transformer. After the tap adjustment has been changed, recheck the operation of the kenotron indicator. This is done by removing one of the kenotrons from its mounting and making certain that the indicator glows in all positions of the technic selector; upon restoring the kenotron note that the glow is eliminated. The same sequence of tests should be repeated for each of the kenotrons.

Before changing kenotrons, be sure that all power is removed from the equipment. This means that the line switch be OFF and the service switch to which the the equipment is connected should be OFF. Remove the metal window cover from the top of the transformer. Be sure the hands are clean and dry before immersing them in oil. Disconnect the kenotron by rolling it out of the contacts holding it. Be careful not to jar the kenotrons when removing them or inserting them.

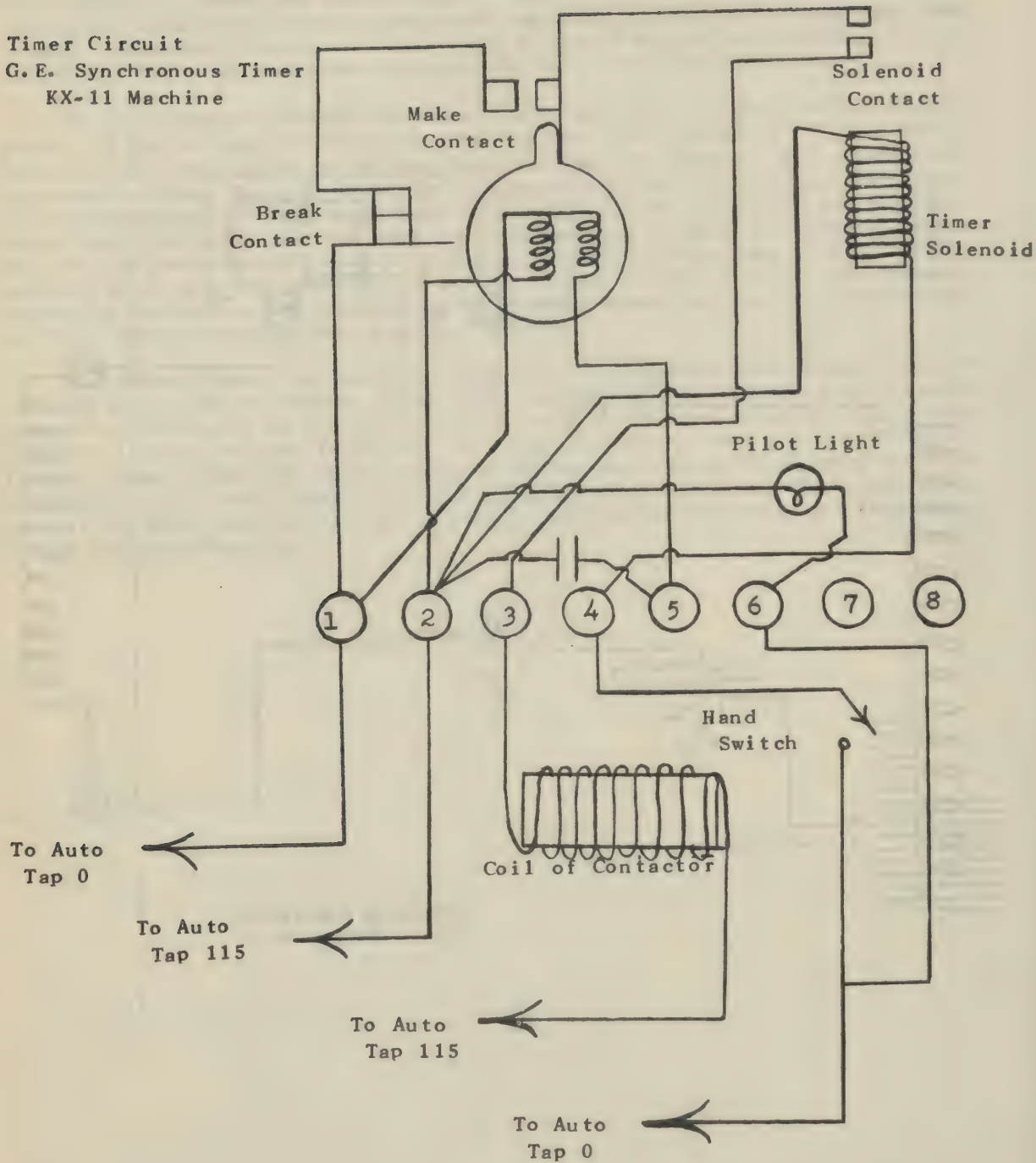
The milliammeter circuit includes a rectifier unit located in the control stand. It can be inspected easily by removing the right side panel of the control. The rectifier tube, which can be seen when the panel is removed, will require replacement in time. However, when this is necessary it will be evidenced by erratic or low reading of the milliammeter or by sparking at the safety gap of the meter rectifier. (The rectifier tube should be replaced with a new R.C.A. type 83 tube.) When this is done the milliammeter should be checked by comparison with a milliammeter of known accuracy connected in series, to make certain that the milliammeter is reading correctly. The performances of the meter rectifier can be ascertained by taking a sample radiograph with a given technic.

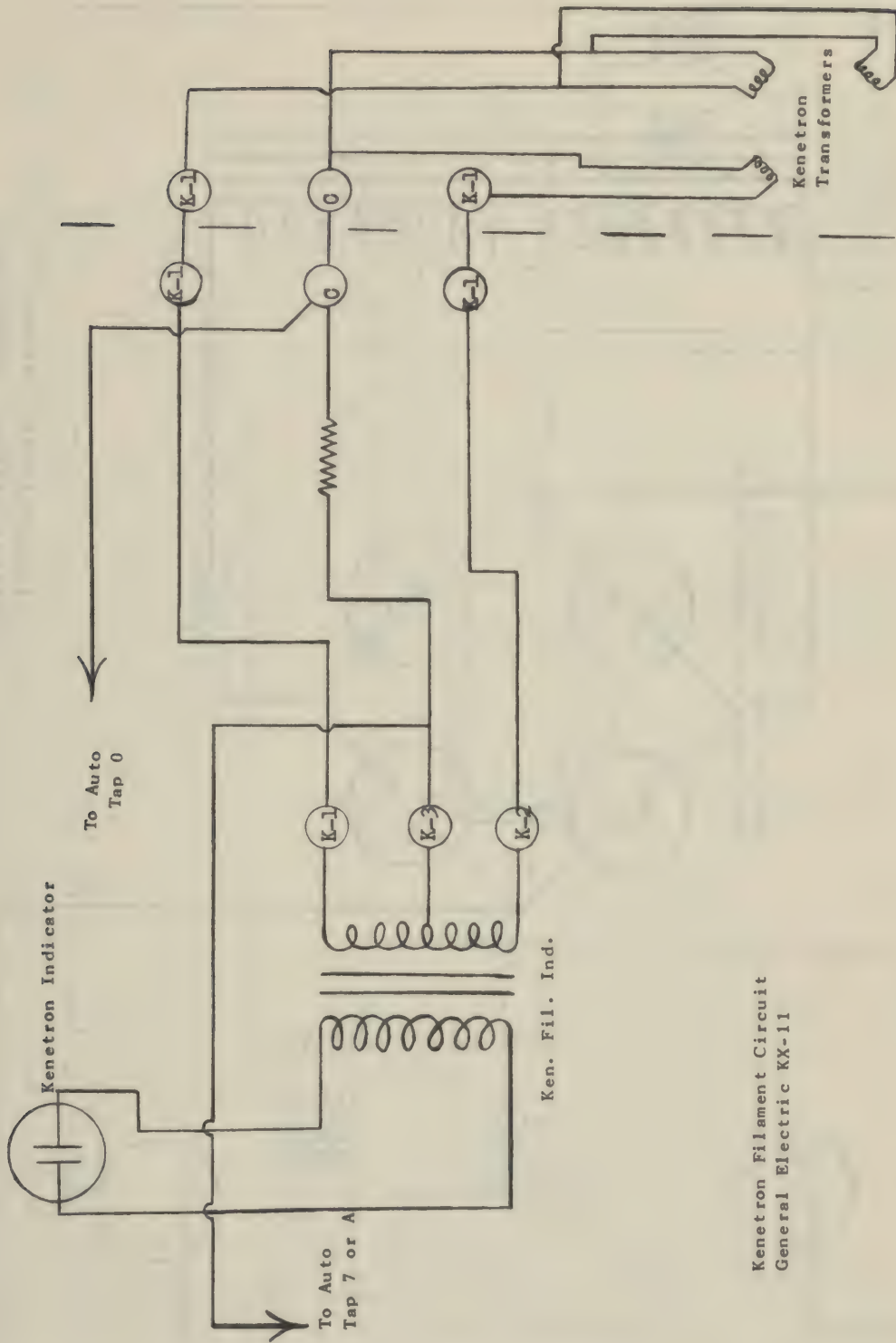
Synchronous Timer: The motor bearings in the Synchronous Timer should be oiled at least once every six months. To do this, remove the three chromium plated screws located approximately at the junction of the thin dome shaped black housing having a smooth finish, and the front heavier circular casting having a black shrivel finish. These screws are located about $2\frac{1}{4}$ inches back of the illuminated notch of the timer face. Three drops of a light grade lubricating oil should be placed in each of the front and rear oil holes, painted red for identification and located on top of the motor housing.



Timer Circuit

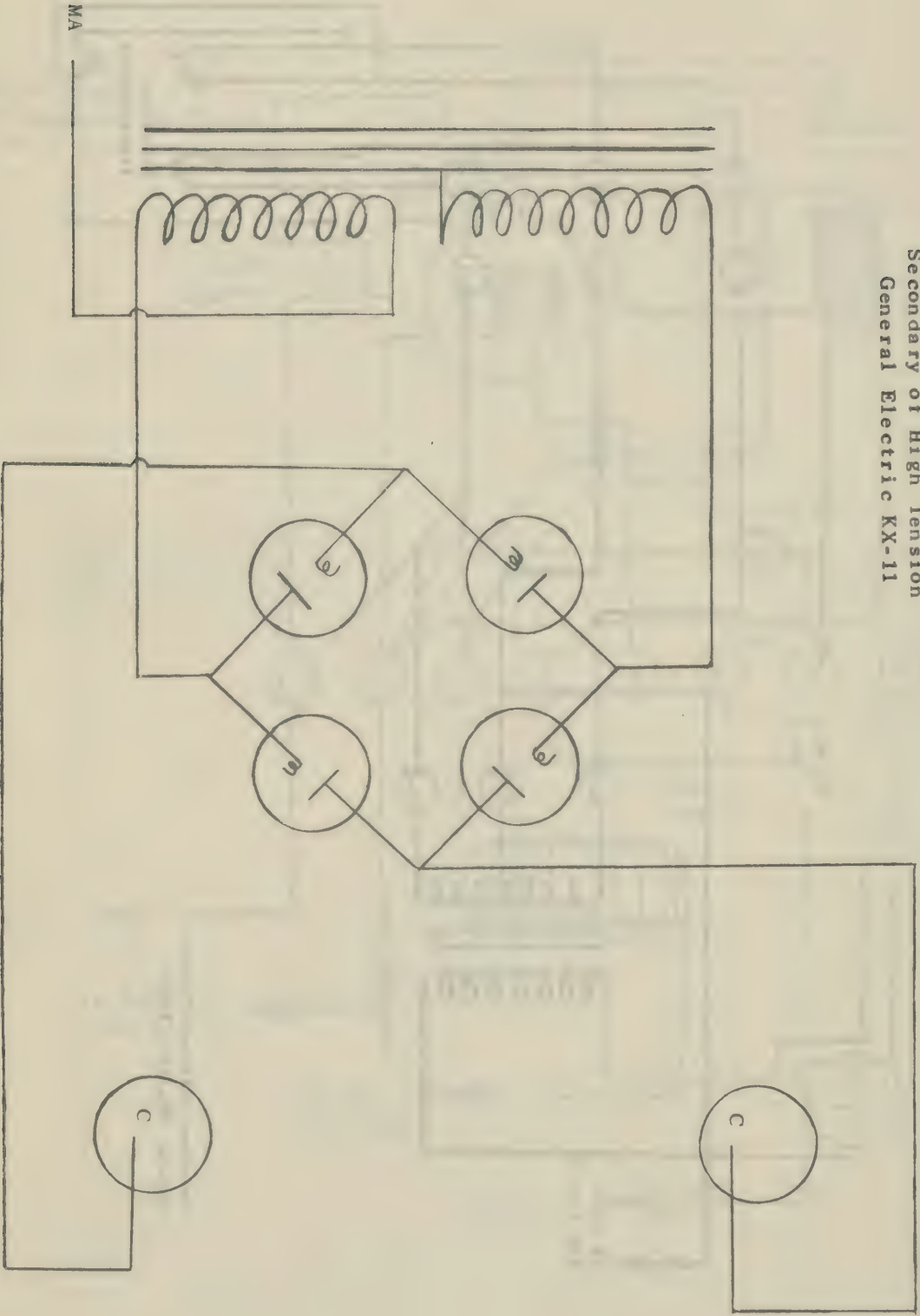
G.E. Synchronous Timer
KX-11 Machine

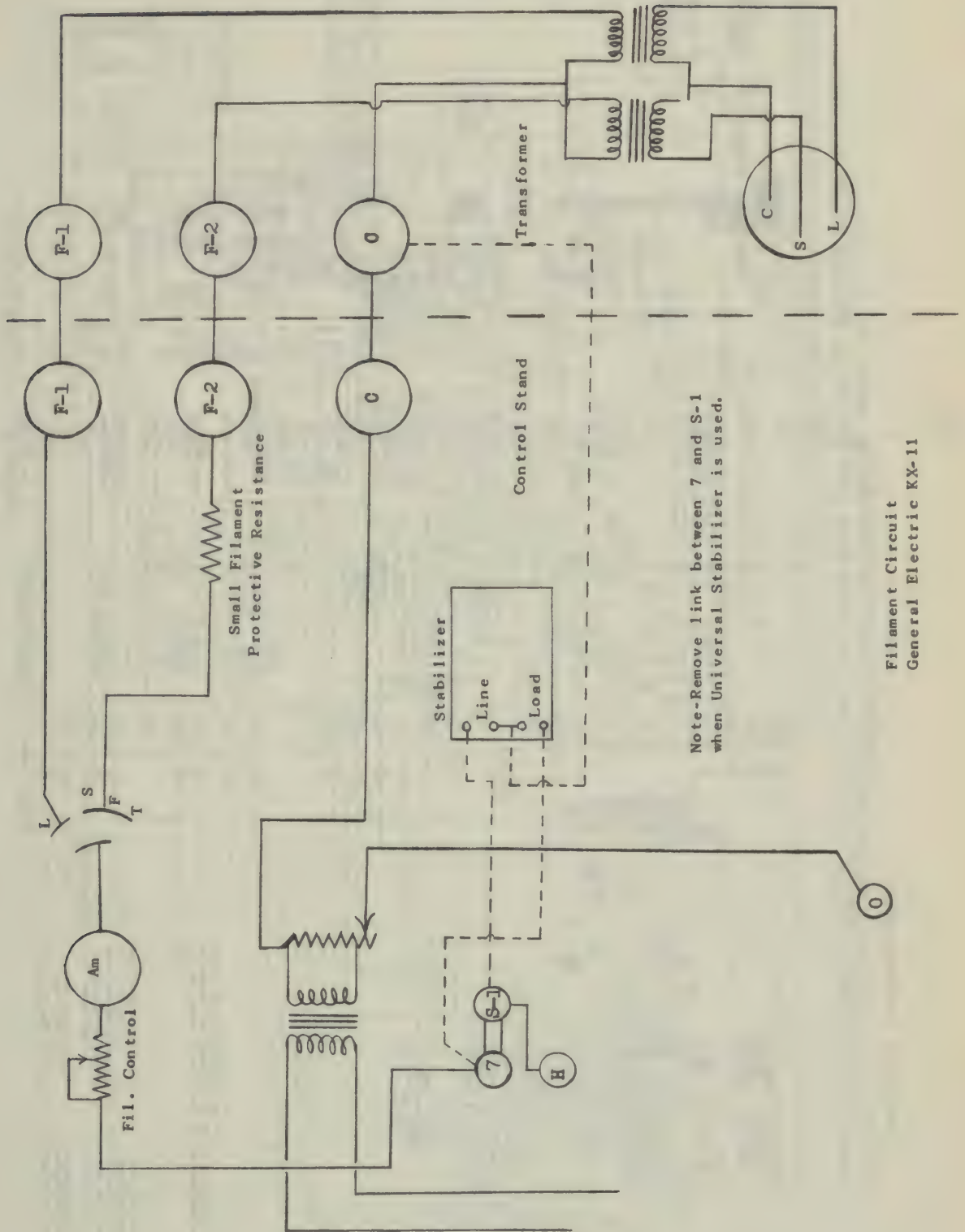




Kenetron Filament Circuit
General Electric KX-11

Secondary of High Tension
General Electric KX-11

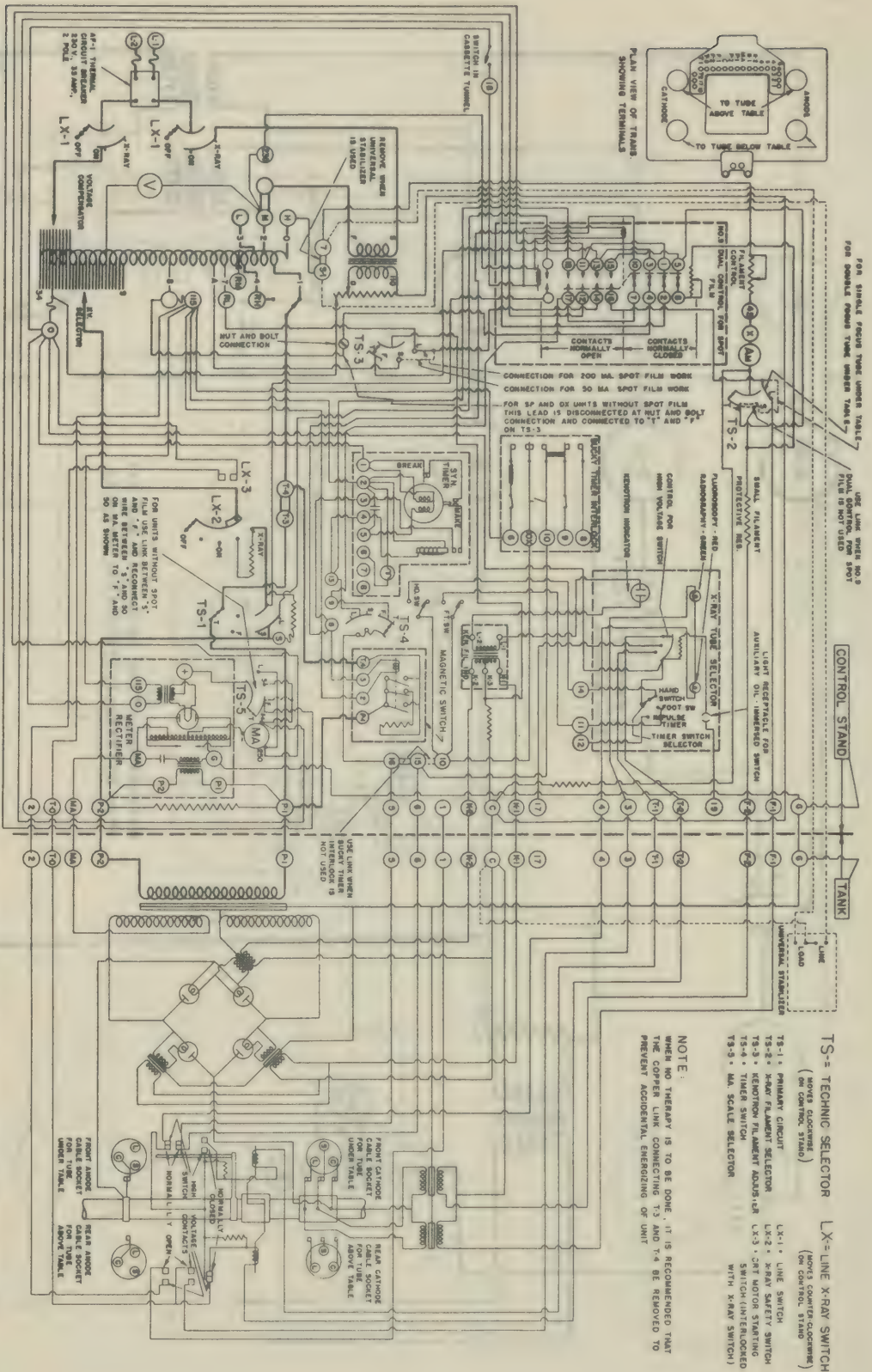




Filament Circuit
General Electric KX-11

SCHEMATIC WIRING DIAGRAM OF KX-11 UNIT WITH SP OR DX TUBE WITH CONNECTIONS TO S-2 OR S-3 SYNCHRONOUS TIMER, NO. 9 DUAL CONTROL, FOR THIS SCHEMATIC APPLIES TO KX-11 UNITS HAVING CONTROL SERIAL NUMBERS 180925 OR HIGHER, AND DUAL CONTROLS SERIAL NUMBERS 182487 OR HIGHER (EXCEPT DUAL CONTROLS 153943 AND 153982). FOR UNITS BELOW THESE NUMBERS, SEE PRECEDING SCHEMATICS.

ENGINEERING SERVICE DEPT. E. E. X-RAY CORP.



SECTION XLVI

200 MA GENERATOR SINGLE TANK - W

SECTION XLVI

ZOO MY GENERATOR SINGLE TANK - W

200 MA GENERATOR SINGLE TANK (W)

Assembly, installation and operating instructions for the Westinghouse 200 MA Fluoradex-E Generator with #981475 control and S#980215 Single Tank 200 MA Transformer.

UNPACKING - Carefully unpack the various boxes and crates in which the equipment is received and examine it for possible damage.

POWER REQUIREMENTS -

Volts:	200 to 250	Frequency:	60 cycles
Amperes:	(Maximum) 80	Phase:	1

WIRING - The equipment may be connected either by means of the interconnecting cables provided, or by running the necessary number of conductors thru conduit. If the latter method is used, the following are the number of conductors and wire sizes required.

Wire sizes for the various conductors *between the control and the high-tension transformer* when run in conduit.

NUMBER OF CONDUCTORS	WIRE SIZE	CONNECT TO TERMINALS
2	#6	A, AA
1	#8	G
9	#14	XFC, XFS, XFL MA, SWC, SWU, SWL, VTC, VT-1

(These are the minimum requirements for the apparatus indicated, and it is advisable to run at least four extra #14 wires to provide for future additional equipment.)

Wire sizes for the various conductors between the control and the power supply line when run in conduit.

NUMBER OF CONDUCTORS	WIRE SIZE	CONNECT TO TERMINALS
2	#6	L-1, L-2
1	#8	G

GENERAL DESCRIPTION - Before attempting to install or operate the apparatus, the following should first be carefully read so that the functions of the various parts and controls will be thoroughly understood.

CONTROL

MAIN SWITCH - The main switch, located on the front of the control body, controls all power to the primary circuits. When set to the "off" position it disconnects the main feed line from the apparatus. When set to the "on" position, the autotransformer is energized, the X-ray and rectifier tube filaments light, and all circuits, with the exception of the high-voltage circuit, become alive. This switch embodies a thermally operated overload circuit breaker which automatically cuts off all current in case of overload.

Should the switch ever trip off automatically due to overload, it can be reset

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as follows: Allow about 20 seconds for the thermal element within the switch to cool; push switch lever firmly to the "OFF" position; then push lever to "ON" position.

When x-rays are not being generated, it is recommended that this switch be kept in the "OFF" position in order to avoid burning the x-ray add rectifier tube filaments unnecessarily.

POTENTIAL CONTROLS - The high-voltage output of the high-tension transformer is controlled by means of the two potential dials.

The coarse control on the left varies the kilovoltage in eight steps of 10 kv each. The fine control on the right varies the kilovoltage in eleven steps of 1 kv each. The coarse and fine controls together combine to give regulations in 1 kv steps over the entire range of the equipment (30 to 100 kv) in fluoroscopy.

The coarse and fine controls together combine to give regulation in 1 kv steps over the entire range of the equipment (30 to 110 kv) in radiography.

The potential dials should never be adjusted without making the necessary corresponding adjustment of both the line voltage regulator and calibration control as called for by the calibration chart on the last page of these instructions. When so set, they indicate fairly accurately, the actual output of the high tension transformer in kilovolts. *FAILURE TO PROPERLY ADJUST THE LINE VOLTAGE REGULATOR AND CALIBRATION CONTROL, PARTICULARLY AT THE HIGHER KILOVOLTAGE SETTINGS, MAY RESULT IN DAMAGE TO THE TRANSFORMER, HIGH TENSION CABLES OR X-RAY TUBE. ADJUSTMENT OF THE POTENTIAL CONTROLS SHOULD NEVER BE MADE WHILE THE X-RAY CIRCUIT IS ENERGIZED.* (See paragraphs on Line Voltage Regulator and Calibration Control.)

LINE VOLTAGE REGULATOR - The line voltage regulator provides a means for conveniently and quickly adjusting the autotransformer in the control so as to compensate for minor variations in line voltage. In use, it is adjusted, *WITH THE VOLT-METER BUTTON DEPRESSED*, until the control line-voltmeter needle points to zero. This adjustment is the basis for the calibration control setting and unless it is properly made, will throw off the entire calibration of the equipment. If difficulty is experienced in getting the control line-voltmeter to read zero (*WITH VOLTMETER BUTTON DEPRESSED*), it is an indication that the line voltage selector strap on the control terminal panel has not been properly set. *ADJUSTMENT OF THE LINE VOLTAGE REGULATOR SHOULD NEVER BE MADE WHILE THE X-RAY CIRCUIT IS ENERGIZED.* (See paragraph on Line Voltage Meter.)

CALIBRATION CONTROL - The calibration control provides a means for adjusting the auto-transformer so that the actual high tension transformer secondary voltage will agree with the values shown on the potential dials for all milliamperage settings. when x-rays are turned on.

Its various positions are indicated on the arbitrary scale of the line-voltmeter, and it should be present only in strict accordance with the calibration chart furnished with the equipment. All settings given are based on "no load" values, i.e., before x-rays are turned on. *ADJUSTMENT OF THE CALIBRATION CONTROL SHOULD NEVER BE MADE WHILE THE X-RAY CIRCUIT IS ENERGIZED.* (See paragraph on Line Voltage Meter.)

FILAMENT REGULATOR - The dual filament regulator is a stepless induction type control which increases or decreases the x-ray tube filament current, which

in turn raises or lowers the milliamperage flowing thru the high voltage circuit of the tube. The upper, or small knob controls the radiographic tube filament: the lower or large knob controls the fluoroscopic tube filament. Turning the controls in a clockwise direction increases filament current; turning them in a counter-clockwise direction decreases it. During fluoroscopy, only the fluoroscopic control is in the circuit. During radiography only the radiographic control is in the circuit. When increasing milliamperage, the controls should be turned slowly so as to avoid the application of excessive currents to the x-ray tube. *BEFORE CONNECTING THE EQUIPMENT TO THE POWER LINE, MAKE CERTAIN THAT BOTH FILAMENT REGULATORS ARE TURNED AS FAR IN A COUNTER-CLOCKWISE DIRECTION AS THEY WILL GO. FAILURE TO TAKE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE X-RAY TUBE FILAMENT WHEN THE MAIN SWITCH IS TURNED ON.* (See paragraph on Filament Meter.)

LINE VOLTAGE METER - The 0-6 line-voltage meter on the left side of the control panel is a dual purpose voltmeter with an arbitrary scale. When used in conjunction with the line voltage regulator setting, the small black voltmeter button on the left of the control must be pressed and held down. The line voltage regulator is then adjusted until the meter reads zero (0).

When used in conjunction with the calibration control setting, the calibration control is adjusted (*WITHOUT PRESSING THE VOLTMETER BUTTON*) until the meter reads the value called for on the calibration chart for the particular kilovoltage and milliamperage selected. (See paragraphs on Line Voltage Regulator and Calibration control.)

FILAMENT METER - the 0-10 filament meter which is controlled by the filament regulators, is an ammeter with an arbitrary scale connected in the primary circuit of the x-ray tube filament transformer. When the control main-switch is turned on, the meter will read the current flowing thru the x-ray tube filament circuit in arbitrary values. Since the milliamperage flowing thru the high voltage circuit of an x-ray tube is, for a given kilovoltage, a direct function of filament temperature, the filament meter provides a means for indirectly indicating in advance, the milliamperage which will be obtained when the x-ray tube is energized. Increasing the filament current raises the milliamperage; decreasing the filament current lowers it.

After the equipment is installed, a careful record should be kept of the filament meter readings for the various milliampere and kilovoltage settings, on the chart provided. Such a chart simplifies the process of presetting the equipment for a desired milliamperage before x-rays are turned on, and contributes much toward longer tube life by making constant preliminary testing before an exposure unnecessary. Since all x-ray tubes, even those of the same type, differ slightly in their filament characteristics, the filament meter values shown at the end of these instructions are of necessity only approximate and should be rechecked in the field at the time the equipment is installed.

MILLIAMMETER - *External Milliampere seconds meter.* Due to the more desirable characteristics of a direct current instrument, control has been provided with a DC milliammeter, with two scales, in place of the usual AC instrument. The specially designed Rectox rectifier unit used with this meter is located on the left rear of the control subpanel.

Range selection for the milliammeter is provided for by means of a small rotary three position switch. When set to the 0-20 position, the low scale of the milliammeter is connected. When set to the 0-200 position, the high scale of the milliammeter is automatically connected. It is recommended that the switch be kept in the 0-20 position for fluoroscopic operation, and in the 0-200 position for radiography.

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CAUTION: Do not switch to the 0-20 scale if the radiographic current is in excess of 20 milliamperes - a burned out meter may result.

The selector switch has also been provided with a third, 0-50 MAS position. This position is provided in the event an external ballistic meter is supplied. The external meter should be connected to terminals MS-1 and MS-2 after the jumper has been removed.

CAUTION: Do not remove the MS-1, MS-2 jumper strip unless an external ballistic meter is used. Failure to observe this precaution may result in a burned out Rectox unit. Do not use the ballistic meter in the fluoroscopic position.

For a given set of conditions, with all factors remaining constant, the degree of exposure or blackening which takes place on the x-ray film becomes a function of milliamperage and the exposure time. In other words, an exposure of 200 milliamperes for 1/10 of a second will produce exactly the same effect as an exposure of 10 milliamperes for 2 seconds. It will be observed that the product of the two factors in both cases equals 20, which is a quantitative value expressed in terms of milliamperes-seconds, i.e. Milliamperes X Time (Seconds) = Milliamperes-Seconds.

However, in the first instance the exposure time of 1/10 of a second is not sufficiently long to allow the needle of the conventional type of milliammeter to arrive at its true reading.

Consequently it becomes necessary to use a ballistic or milliamperes-seconds type of meter on all exposures of 1/5 of a second or faster. It is inadvisable to use the milliamperes-seconds meter for exposures longer than 1/5 of a second, such as 1/4, etc., since this type of meter becomes correspondingly less accurate on the longer exposures.

INSTRUMENT ILLUMINATION - Instrument illumination is provided by means of the meter light located directly below the three meters, and the potential-dial light located on the sub-panel directly underneath the two potential dial windows.

Replacement bulbs may be ordered from the Westinghouse X-Ray Division as No. 36-626.

They are also available at all electrical supply houses as Westinghouse 5W-115 volt type S-6 candelabra base bulbs.

LIGHT SWITCH - The toggle switch marked "LIGHTS" controls the instrument illuminating lights should be turned off when not required. This switch does not affect the red indicator lights.

FOCUS SELECTOR SWITCH - The toggle switch marked "FOCUS" provides a means for selecting either the large or small focal spot of the radiographic x-ray tube when the equipment is to be used for radiography. The switch becomes inoperative during fluoroscopy.

The two small red pilot lights, which indicate on which focal spot the equipment is operating, are wired in series with the primary circuits of the two x-ray tube filament transformers. Should either one of them fail to light when the focus selector switch is thrown, and the bulb itself has not burned out, it will be an indication of either a burned out x-ray tube filament, or an open circuit elsewhere in the filament circuits.

WHEN REPLACING THESE BULBS, IT IS OF THE UTMOST IMPORTANCE THAT BULBS OF THE SAME TYPE AS THOSE FURNISHED WITH THE EQUIPMENT BE USED. FAILURE TO TAKE THIS PRECAUTION MAY UPSET THE FILAMENT CIRCUITS. When ordering replacement bulbs, refer to Westinghouse Style #980218-A Mazda Lamp No. 64 - 3CP-6 to 8 volts - G-6 - D.C. Base.

FLUOROSCOPIC-RADIOGRAPHIC SWITCH - The toggle switch marked "fluoroscopy" "radiography" provides a means for quickly and automatically setting the equipment for one or the other.

With the switch in the fluoroscopic position, the fluoroscopic tube, fluoroscopic filament regulator and foot switch, are cut into the circuit. The milliammeter selector switch should be set for the 0-20 ma position. The high tension transformer is also automatically connected to the fluoroscopic tube by means of the high tension switches contained within the transformer tank. The trigger switch, bucky, timer and focus selector switch, are all inoperable during fluoroscopy.

With the switch in the radiographic position, the radiographic tube, radiographic filament regulator, trigger switch, bucky-timer switch and focus selector switch are cut into the circuit. The milliammeter selector switch should be set for the 0-200 ma position. If an external ballistic meter is provided set for 0-50 MAS, depending on the particular technique being applied. The high tension transformer also automatically connected to the radiographic tube.

The footswitch, fluoroscopic tube and fluoroscopic filament regulator are inoperable during radiography. The low (0-20) scale of the milliammeter is also out of the circuit unless the ma circuit selector switch is in 20 ma position. *DO NOT USE THE 0-20 MA RANGE IF THE CURRENT IS IN EXCESS OF 20 MILLIAMPERES.*

TIMER-BUCKY SWITCH - The toggle switch marked "Timer-Bucky" provides a means for selecting either the timer or the bucky when the equipment is to be used for radiographic work. It is inoperable during fluoroscopy. With the switch in the "Timer" position, the radiographic exposure is controlled by the micro-timer and the trigger switch.

With the switch in the "Bucky" position, the bucky is released by the trigger switch and the exposure is timed by the micro-timer.

CONTROL TERMINAL IDENTIFICATION - (See Drawing 2-B-8981.) As a rule all control terminals which connect to the high tension transformer are identified to correspond to similar markings on the transformer terminals. In instances where such is not the case, special instructions are provided.

The six heavy studs arranged in an arc and marked 200, 210, 220, 230, 240, and 250 volts are the line voltage selector terminals. These provide a means for adapting the equipment to various line voltages. After the line voltage has been determined by means of an accurate AC voltmeter, the line voltage selector strap should be connected to the terminal whose value corresponds closest to the indicated voltage.

The 11 small studs arranged in an arc are used for adjusting the valve tube filament voltage. The flexible jumper from terminal VT-1 is connected to the stud which provides the correct valve tube filament voltage. (See paragraph on Valve Tubes.) The studs on the left (as viewed from the rear) supply the lowest voltage, while the studs on the right supply the highest voltage.

The VTC and VT-1 studs are the valve tube filament transformer primary terminals.

The VTL, VTL-1 and X studs provide a means for quickly adapting the equipment to either the brass base type or Kovar base type WL-386 valve tube, both of which differ somewhat in their filament characteristics. Either VTL and X or VTL-Q and X (depending on which of the two types of tubes is used) must at all times be joined together by means of the jumper strap provided. (See paragraphs on Valve Tubes and on Assembly.)

NOTE: Stud VTH serves merely as an internal anchor terminal and should be disregarded when connecting the equipment.

The XFC stud is the "common" x-ray tube filament transformer terminal. It is common to both the XFS and XFL terminals.

The XFS stud is the "small focus" x-ray tube filament transformer terminal.

The XFL stud is the "large focus" x-ray tube filament transformer terminal.

The CC, C-1 and C-2 studs are the trigger switch terminals. Stud CC is common to both C-1 and C-2

NOTE: For Rotating Anode Tube connections see addendum.

The MA stud is the milliammeter circuit terminal. The other side of the milliammeter circuit connects to ground within the control.

The BC and BMC studs are the bucky contact terminals.

The BM and BMC studs are the bucky magnetic terminals.

The SWL, SWU and SWC studs are the control terminals for the high tension switches contained in the high tension transformer tank. Stud SWC is common to both SWL and SWU.

Disregard studs SWT and SWR on the control when connecting the equipment. They are spare terminals and are not required on this particular unit.

The SM-1, SM-2 terminals provide a separate source of 115 volts AC for use on external accessories. The maximum capacity of this circuit is 10 amperes and the total connected load should never exceed this value. No current supply is available from these terminals when the control main-switch is set to its "OFF" position. Consequently, any equipment which is required to operate when the control is shut down should not be connected to these terminals.

The B and CB-2 studs are the micro-timer Synchronous motor terminals.

The CB-1 and CB-3 studs are the micro-timer contact terminals.

The CB-2 and CB-3 studs are the micro-timer clutch terminals.

If it is desired to use an L.F. synchronous timer in place of the Micro-timer, connect it to the above terminals as follows: PB, AC on L.F. timer to B on control. TC on L.F. timer to CB-1 on control. AC on L.F. timer to CB-2 on control. TC, PB on L.F. timer to CB-3 on control.

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The FS, FS studs are the fluoroscopic footswitch terminals which connect to the x-ray table.

The RL, RL studs are the room light terminals to which a fluoroscopic "accommodation light" can be connected if desired. They supply no voltage but merely function as a supplementary switch to open and close a circuit.

The circuit is closed when x-rays are off, and open when x-rays are on. Since the light will continue to burn even after the control has been turned off, an additional room switch should be provided.

The heavy L-1, L-2 studs are the power supply terminals and connect directly to the main line.

The heavy A, AA studs are the high tension transformer primary terminals.

The heavy G stud is the ground terminal.

The four IN, OUT, IN, OUT studs, which are tied together in pairs by two jumper straps when the control leaves the factory, provide a convenient means for connecting a milliampere stabilizer to the equipment should local power line voltage fluctuations make its use advisable. The S#979994 milliampere stabilizer, which is available as an additional accessory, should be connected as shown on wiring diagram 2-B-8981 *after first removing and discarding the two jumper straps.*

When no stabilizer is used, the upper IN terminal should be connected to the upper OUT terminal, and the lower IN terminal to the lower OUT terminal by means of the two jumper straps provided. Good electrical contact should be maintained between the straps and terminals at all times so as to avoid erratic filament operation. Removal of either of the straps, unless a stabilizer is used, will result in an open filament circuit.

Terminals MS-1 and MS-2 are the control studs to be used when an external ballistic meter is used. The jumper strap must be removed only when the external ballistic meter is connected to the control terminal panel.

Stud MS-1 connects to the positive terminal of the external ballistic meter.

Stud MS-2 connects to the negative terminal of the external ballistic meter.

CONTROL RECEPTACLES - Two female receptacles are provided on the lower right side of the control board.

The upper, which will accept only the special lock-in plug furnished, provides a separate source of 115 volts AC for miscellaneous applications. The maximum capacity of this outlet is 10 amperes and the current supply will be cut off when the control is shut down. Giving the plug a quarter turn in a counter-clockwise direction will permit its removal from the receptacle. The lower receptacle provides a means for connecting an additional foot-switch or hand operated push button for fluoroscopic operation.

TRIGGER SWITCH - The hand trigger switch, which is used only on radiographic work, is provided with two triggers which must be operated in the proper sequence, and in strict accordance with the operating instructions if damage to the apparatus is to be avoided.

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Both triggers are mechanically interlocked to minimize the possibility of using them in the incorrect sequence i.e., the upper or index finger trigger cannot be depressed until the lower or hand-squeeze trigger has first been pressed. In operation, pressing the hand-squeeze trigger boosts the valve tube filament voltages to proper value of an exposure. The actual exposure is then made by pressing the index finger trigger (with the hand-squeeze trigger still depressed). Upon completion of the exposure, both triggers may be released.

FILAMENT CURRENT LIMITING RESISTORS - Two adjustable filament current limiting resistors are provided at the rear of the control.

Their purpose is to minimize the possibility of applying excessive filament currents to the x-ray tubes, either thru the carelessness of the operator, or when switching from the large to the small filament as is the case when changing focal spots. The one on the left (as viewed from the rear) is the fluoroscopic resistor. It has one sliding adjustment which, when raised reduces the filament current, and when lowered increases it.

The one on the right (as viewed from the rear) is the radiographic resistor. It has two sliding adjustments, the upper one controlling the small focus filament and the lower one the large focus filament. Raising either of these adjustments reduces the filament current, lowering them increases it.

Both resistors have been carefully set at the factory and their adjustments should not be changed unless it is found impossible to reach the upper milliampere range of the equipment.

When such is the case, and all other possible causes for the condition, including the x-ray tube, have first been investigated, the filament current may be gradually increased until satisfactory operation is obtained.

After the adjustment is completed, make certain that the locking screw on the sliding collar is tightened sufficiently to assure good contact.

HIGH TENSION TRANSFORMER - The No. 980215 oil insulated high tension transformer furnishes high potential, as well as filament current for both the valve and x-ray tubes.

It consists of two sections, the one with the viewing window containing four valve tubes (which are shipped separately) four valve tube filament transformers, and the anode side of the high tension switch. The other section contains the high tension transformer, the x-ray tube filament transformer, the small 0.01 mfd. compensating condenser, and the cathode side of the high tension switch. (For valve tube installation data see paragraph on Valve Tubes.)

Four high tension cable sockets are provided, the two marked "U" being for the upper or radiographic tube, and the two marked "L" being for the lower or fluoroscopic tube.

The transformer should be permitted to stand in a warm room (70°F or higher) for at least six hours after shipment, with its breathing vent open, before operating, in order to allow air bubbles trapped in the oil to rise to the surface. The oil level, which should be checked before putting the unit into service, and every six months thereafter, must be maintained to within approximately 1/4 inch of the underside of the top panel. If it becomes necessary to add fresh oil, use only the No. 2772 Wemco "C" transformer oil furnished with the equipment.

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Additional oil of this type is available in one quart, one gallon, thirty gallon, and fifty gallon containers.

NOTE: BE CAREFUL NOT TO CONTAMINATE THE INSULATING OIL WITH DIRTY HANDS, TOOLS, OR MOISTURE WHEN WORKING ON THE INTERIOR PORTIONS OF THE TRANSFORMER. FAILURE TO MAKE THIS PRECAUTION MAY RESULT IN SERIOUSLY IMPAIRING THE DIELECTRIC QUALITY OF THE OIL.

VALVE (RECTIFIER) TUBES - Four oil immersed WL-386 or similar high voltage valve (rectifier) tubes are used in the style #980215 transformer.

They are shipped separately and should be installed in strict accordance with the assembly instructions. When the control main switch is first turned on, the valve tube filaments will light, but at a level below that which is required for an x-ray exposure. With the valve tubes in this condition, the valve tube filament transformer primary voltage as measured across the VTC, and VT-1 terminals is referred to as the "Unboosted Voltage".

When the hand-squeeze trigger of the trigger switch is pressed before an exposure the valve tube filament voltage is suddenly increased to the high value required for an x-ray exposure. With the valves in this condition, the voltage as measured across the VTC and VT-1 terminals is referred to as the "Boosted Voltage".

Such an arrangement contributes greatly to prolonged valve tube life since the tubes burn at maximum intensity only for a short interval during an x-ray exposure.

Some valves used in these transformers may have their maximum operating voltages indicated on the valve itself.

There are two current types of WL-386 valve tubes which differ somewhat in the characteristics of their filaments and the dimensions of their metal bases. Either type can be used interchangeably in this equipment providing the necessary filament voltage correction is made. (See paragraph on Assembly.) However, all four tubes must be of the same type, i.e., they cannot be used in mixed combinations in the same transformer.

The brass base WL-386 valve tube has a slightly smaller base diameter than the other type and its filament voltage, as measured across the VTC and VT-1 transformer terminals is:

176 volts unboosted
192 volts boosted

NOTE: The voltage across the valve tube terminals should be carefully measured with an 0-15 volt A.C. meter. Check the voltage across each tube.

Secondary Voltages

10.3 volts unboosted
11.35 volts boosted

The Kovar base WL-386 valve tube, which can be readily identified by the gray color of the metal base, has a slightly larger base diameter than the other type, and its filament voltage, as measured across the VTC and VT-1 transformer terminals is:

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154 volts unboosted
194 volts boosted

NOTE: The voltage across the valve tube terminals should also be carefully measured with a 0-15 volt A.C. meter. Check the voltage across each tube.

Secondary Voltages

9.8 volts unboosted
12.30 volts boosted

The valve tube filament voltages have been set at the factory for the particular type valves supplied with the equipment, but the settings should be checked before operating the apparatus, by connecting a 0-250 AC voltmeter across the VTC and VT-1 transformer terminals and following the procedure outlined in paragraphs under "Assembly".

If an adjustment is indicated, connect the flexible VT-1 jumper on the control terminal panel to the proper stud in the group of 11 valve tube filament terminals arranged in an arc. (See paragraph on "Terminal Identification before preceeding.")

NOTE: The line voltage selector strap on the control terminal panel must always be adjusted to conform to the line voltage, and the line voltage regulator must always be set to zero before taking valve tube readings. Failure to make these adjustments properly will result in erroneous voltage settings with consequent damage to the valves.

ASSEMBLY - Assemble the equipment carefully and in accordance with the step by step instructions which follow. If any step is not clear, refer to the paragraph dealing with the item in question under "General Description", before proceeding.

After placing the transformer and control in the desired positions, proceed as follows:

Remove the sheet metal housing from the control. Remove the decorative cover from the top of the transformer. Remove the breathing vent screw from the oil filler plug located on top of the transformer.

Mount the micro-timer or L. F. timer on the rear of the control by means of the bracket and screws provided.

Remove the 20 screws which hold the transformer top panel with the viewing window to the tank flange. (The other top panel need not be disturbed.)

Lift the panel assembly straight up out of the tank sufficiently to expose all four valve tube brackets and block it up with convenient pieces of clean lumber.

Carefully remove the four WL-386 valve tubes from the crates in which they are packed. Clean them thoroughly using a lint-free cloth and carbon tetrachloride so as to avoid all possibility of foreign substances entering the oil and destroying its dielectric quality.

Insert the metal ends of the valves into the four circular mounting clamps in the transformer. Two of the valves will be suspended with their filament ends up, and two with their filament ends down. Tighten the clamp-screws so that the valves are held firmly in place.

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NOTE: (The two copper wire shim-straps which are wrapped around each clamp should be left in place when the brass base type of WL-386 valves are used. They are required because of the smaller diameter base of this tube. With the gray Kovar base valves, the shims should be removed.)

Connect all four valves to their respective filament transformers which are located near the filament end of each tube. Make certain that the lugs are spaced sufficiently far apart to prevent short-circuiting.

Lower the panel assembly back into the oil slowly taking care to keep it in the center of the compartment and perpendicular, by holding it against the guide angle provided on the inner wall of the tank. (These precautions are necessary in order to avoid bending the three high voltage contact springs which are supported by insulators from the top and bottom of the tank, and which carry high voltage from the high tension transformer compartment to the valve tube compartment. If any difficulty is experienced in obtaining high voltage when the equipment is first operated, these spring contacts should be investigated.)

Connect corresponding terminals SWU, SWC, SWL, VTC and VT-1 of the right and left sides of the transformer together. (Use no wire smaller than No. 14.) Then connect terminals AA, A, MA, G, XFC, SFL, XFS, VTC, VT-1, SWU, SWL and SWC, to correspondingly marked terminals on the control.

On controls on which no SWC terminal has been provided, connect terminal SWC from the transformer to the terminal on the control marked SM-1 and BM.

Connect control terminals BC and BMC to the bucky contacts in the x-ray table.

Connect control terminals BM and BMC to the bucky release magnet in the x-ray table.

NOTE: The above four connections may be made with three conductors since BMC is common to both BC and BM.

Connect control terminals FS, FS to the foot switch receptacle in the x-ray table.

Connect control terminals B, CB-1 CB-2 and CB-3 to correspondingly marked terminals on the micro-timer. (If an L.F. synchronous timer is to be used in place of the micro-timer, connect it to the B, CB-1, CB-2 and CB-3 control terminals as outlined in paragraph on control terminal identification.)

Connect control terminals CC, C-1 and C-2 to the correspondingly marked lugs of the hand trigger switch.

Connect control terminals RL, RL to the fluoroscopic accommodation light circuit if such facilities have been provided.

Connect the shock-proof high tension cables to the transformer and tubeheads. Each tube requires one cathode and one anode cable, the former having three conductors and the latter only one conductor.

In connecting the cables to their respective units, **DO NOT PERMIT THEM TO DROP INTO THE HIGH TENSION SOCKETS**. Insert the ends carefully, using the slot in the socket collar, and the pin on the cable fitting as guides. When it is certain that the cable has entered the socket fully, lock the assembly by screwing down the round cable nut.

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The two transformer cable sockets stamped with the letter "U" connect to the upper or radiographic tube, while those stamped with the letter "L" connect to the lower or fluoroscopic tube.

Set the potential dials at 30 kv. Turn both filament regulators and all other controls in a counterclockwise direction as far as they will go so that they are in their "minimum" positions.

Measure the incoming line voltage with a good AC voltmeter (0-300 volts) and set the line voltage selector strap on the control terminal panel to the stud corresponding closest to the indicated value. (See paragraph on Terminal Identification.)

Connect the incoming power line to studs L-1 and L-2 on the control. Connect the "G" terminal on the control to a good ground.

Check the valve tube jumper strap on the control terminal panel (see paragraph on Terminal Identification) and make certain that it connects terminals X and VT-1 when the brass base type WL-386 valve tubes are used, and terminals X and VTL when the gray Kovar base type WL-386 valve tubes are used.

Connect a good AC voltmeter (0-250 volts) across the VTC and VT-1 studs on the control terminal panel. (Do not remove any of the connections.)

Set the "Fluoroscopy-Radiography" toggle switch to the "Radiographic" position.

Turn on power and set the control main switch to its "ON" position. (See paragraph on Main Switch.) Look into the window on top of the high tension transformer and make certain all four valves are lighted.

Press the line voltmeter button (holding it down) and adjust the line voltage regulator to zero (0) as outlined in the paragraph on Line Voltage Regulator.

The VTC and VT-1 "unboosted" valve tube filament transformer primary voltage should now read 176 volts if the brass base type WL-386 valve tubes are used, and 154 volts if the gray Kovar base type WL-386 valve tubes are used.

If an adjustment is indicated, proceed as outlined in the paragraph on Valve Tubes.

Press the *hand squeeze trigger* of the trigger switch and hold it down. This boosts the valve tube filament transformer primary voltage. **DO NOT PRESS THE INDEX FINGER TRIGGER.** The VTC, VT-1 "boosted" valve tube filament voltage should now read 192 volts if the brass base type WL-386 valve tubes are used, and 194 volts if the gray Kovar base type WL-386 valve tubes are used. If an adjustment is indicated, the VTH terminal tap on the autotransformer will have to be changed within the control. (See control wiring 2-B-8981.) However, before making this change, make certain that the foregoing instructions have first been carefully followed. (See paragraph on Valve Tubes.)

Assuming the valve tube filament settings are satisfactory, the equipment is now ready for operation.

After taking all the usual precautions against high voltage, and exposure to x-rays, proceed as follows:

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The paragraph references shown at the end of each of the following steps refer to sections of the instructions in which the use and operation of the various components is explained.

If an external ballistic meter is used, remove the MS-1-MS-2 jumper strap, connect the ballistic meter positive lead to stud MS-1, connect the ballistic meter negative lead to stud MS-2.

FLUOROSCOPIC OPERATION - Set the "Fluoroscopy-Radiograph" toggle switch to the fluoroscopic position.

Set the two potential controls to the desired kilovoltage.

Turn on the control Main Switch.

Press the line voltmeter button (holding it down) and adjust the Line Voltage Regulator until the Line Voltmeter reads zero (0). Then release the button.

Refer to the preliminary calibration chart at the end of these instructions.

Preset the Calibration Control (as indicated by the line voltmeter without the button depressed) to the value shown for the kilovoltage and milliamperage selected.

Preset the (lower) fluoroscopic Filament Regulator (as indicated by the filament meter) to the value shown on the calibration chart for the milliamperage selected. This will vary slightly with the different kilovoltage.

NOTE: DO NOT EXCEED VALUES SHOWN ON THE TUBE RATING CHART FOR CONTINUOUS FLUOROSCOPIC OPERATION.

Set the milliampere range selector switch to its 0-20 MA position.

Step on the footswitch and observe the milliammeter. The actual value in milliamperes will be shown on the lower (0-20) scale. If the milliammeter does not indicate the exact value selected, the filament regulator may be adjusted while x-rays are on until the desired reading is obtained. The filament meter reading for the indicated milliamperage should be then recorded on the final calibration chart for future reference.

RADIOGRAPHIC OPERATIONS - Set the "Fluoroscopy-Radiography" toggle switch to the Radiographic position.

Set the "Timer-Bucky" toggle switch to the position desired.

Set the "focus" toggle switch to either the "large" or "small" position. Since the focal spot which may be used is determined by the milliamperage, kilovoltage, and time selected, the tube rating chart should be referred to before setting this switch.

Set the two potential controls to the desired kilovoltage.

Turn on control main switch.

Press the line voltmeter button (holding it down) and adjust the line voltage regulator until the line voltmeter reads zero (0). Then release the button.

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Refer to the preliminary calibration chart at the end of these instructions.

Preset the calibration control (as indicated by the line voltmeter without the button depressed) to the value shown for the kilovoltage and milliamperage selected.

Preset the (upper) Radiographic Filament Regulator (as indicated by the filament meter) to the value shown on the calibration chart for the milliamperage selected. This will vary slightly with the different kilovoltages.

Set the micro timer or L.F. Timer for the desired time. If a micro timer is used, turn on the micro-timer motor switch. If an exposure time, slower than 1/5 of a second is selected the milliamperage range selector switch should be set to its 0-200 MA position. If an exposure time of 1/5 of a second or faster is selected, the milliamperage range selector switch should be set to its 0-50 MAS position connected to the external ballistic meter in the circuit. For radiographic work below 20 MA, the milliamperage range selector switch may be set to its 0-20 MA position.

NOTE: THE MAXIMUM CAPACITY OF THIS EQUIPMENT ON RADIOGRAPHY IS AS FOLLOWS:

200 MA-100 KVP--	1/5 SECONDS
100 MA-100 KVP--	3 SECONDS
30 MA- 90 KVP--	25 SECONDS
20 MA-110 KVP--	20 SECONDS

ALWAYS ALLOW SUFFICIENT IDLE TIME BETWEEN EXPOSURES TO AVOID OVERHEATING OF THE X-RAY TUBE.

Press the lower or hand squeeze trigger of the trigger switch and hold it down. After about two seconds, and without releasing the lower trigger, press the upper or index finger trigger and hold it down until the exposure is completed.

It is good practice to always observe the milliammeter during an exposure to make certain that the required milliamperage has been obtained.

If an exposure of 20 milliamperes or less is to be made, adjust the milliamperage range selector.

NOTE: ALWAYS ALLOW THE REQUIRED TWO (2) SECOND TIME LAPSE BETWEEN PRESSING THE LOWER AND UPPER TRIGGERS. THIS PERMITS THE VALVE TUBE FILAMENTS TO COME UP TO THEIR PROPER TEMPERATURE, AND PREVENTS POSSIBLE DAMAGE AND UNDEREXPOSURE.

Turn off timer motor and control main switch to shut equipment down after the exposure is completed.

If the equipment has operated satisfactorily, the 20 screws which were removed from the transformer top panel, as well as all sheet metal housings, should be replaced.

OPERATING PRECAUTIONS - Always refer to the calibration chart before making current or voltage settings.

Always refer to the tube rating charts before making an exposure and never exceed the maximum values shown.

Do not keep the control main switch in the "ON" position needlessly when x-rays

are not being generated. This avoids unnecessary burning of the x-ray and valve tube filaments and contributes greatly toward longer tube life.

CALIBRATION

Since a number of variable conditions such as differences in power line and x-ray tube characteristics must be compensated for on each new installation, the calibration data obtained on factory tests are very likely to be found only approximately correct when the equipment is connected to another lower source.

They are intended to serve only as a basis for preliminary operation, and a complete and final photographic calibration check should be made before attempting routine operation. An additional blank form is provided for this purpose.

Care should be exercised to avoid subjecting the x-ray tube to conditions in excess of its rating during calibration. See the tube rating chart before proceeding.

SUPPLEMENTARY INSTRUCTIONS

In cases where an external timer is mounted on the back of the pedestal controls, the following precautionary measure should be followed.

The four conductor short interconnecting cable between the Westinghouse S#977208 Micro-timer and the control terminal panel should be run into the control directly below the timer mounting bracket. A hole drilled into the top panel frame is provided for this purpose. After the cable has been placed through this hole, it should be run directly over to a small hole drilled into the sub-panel. This hole is approximately below the small step potential dial. The cable should then be placed through this hole and connected to its similarly marked terminal studs on the control terminal panel; B, CB-1, and CB-3.

Following this procedure brings the timer cable away from the filament current limiting resistors, which normally become heated during operation of the control. The presence of the cable near these normally hot resistors may result in subsequent damage to the timer interconnecting cable.

ROTATING ANODE TUBE TERMINALS (if used) - If either a Westinghouse type WRA 1-2 or Machlett Dynamax rotating anode tube is to be used for radiographic work, terminals 1, 2, 3, 4, 5 and 6 on the rotating anode tube starting box should be connected to the following terminals on the control. (Connections from other portions of the equipment to the control terminals in question should not be disturbed except where indicated.)

Terminal 1 on RA starting box to terminal C-1 on control.

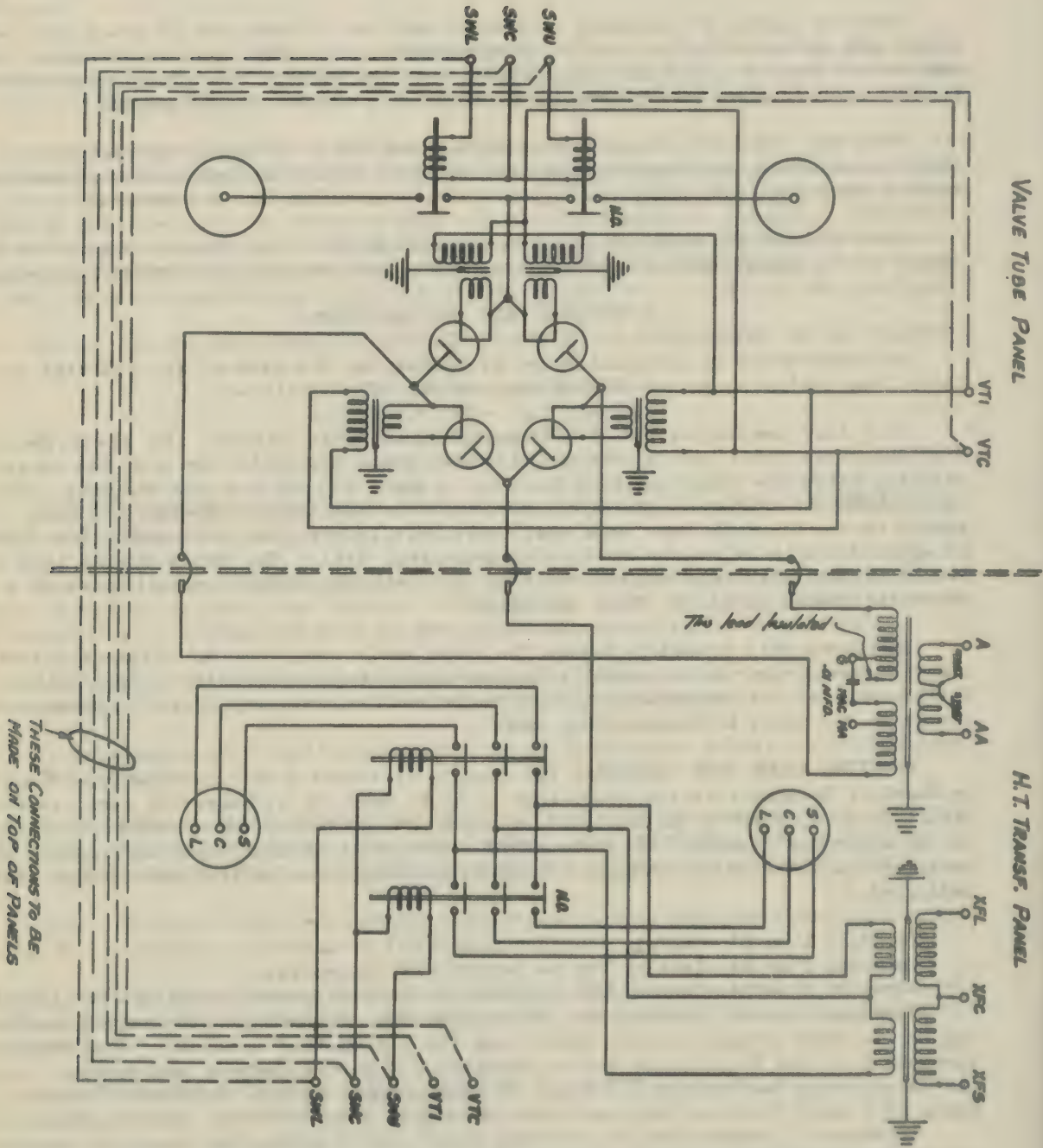
Terminal 2 on RA starting box to terminal CC on control.

Terminal 3 on RA starting box requires no connection and should be disregarded.

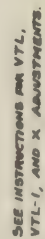
Terminal 4 on RA starting box to terminal SM-1 on control. Disconnect the C-2 lug on the hand trigger switch cable from the C-2 control terminal. Then connect terminal 5 on the RA starting box to terminal C-2 on the control, and terminal 6 on the RA starting box to the C-2 lug. The connection to the lug should be made by means of a small bolt and nut, and then thoroughly insulated with friction tape.

Terminals 7, 8 and 9 on the rotating anode tube starting box should be connected to the tubehead by means of the special color-coded cable provided. The black lead connects to terminal 7. The red (or green) lead connects to terminal 8. The white lead connects to terminal 9. The polarized plug at the other end of this cable should be inserted into its receptacle on the tubehead.

200 MA GENERATOR SINGLE TANK (W)



WESTINGHOUSE X RAY CO. INC
ENC. 300 N. 4TH ST. PITTSBURGH, PA.
SCALE NONE
BILL OF MATERIAL CHART
Dwg. 3.0-1901 SUB 1



2-B-8981

200 MA GENERATOR SINGLE TANK (W)

MODEL OF A FACTORY

PRELIMINARY CALIBRATION

Transformer Style No. _____ Control Style No. _____

Transformer Serial No. _____ Control Serial No. _____

Adjust controls in the sequence numbered.

1

2

3

MA	KV	Line Voltage Regulator Preset	Calibration Control Preset	Filament Regulator Preset
5	60	0		
10	60	0		
20	60	0		
30	60	0		
50	60	0		
60	60	0		
100	60	0		
150	60	0		
200	60	0		
200	100	0		

200 MA GENERATOR SINGLE TANK (W)

MODEL OF A FACTORY

FINAL CALIBRATION

Transformer Style No. _____Control Style No. _____

Transformer Serial No. _____Control Serial No. _____

Adjust controls in the sequence numbered.

1

2

3

MA	KV	Line Voltage Regulator Preset	Calibration Control Preset	Filament Regulator Preset

TO BE FILLED OUT BY THE SERVICEMAN AND LEFT AT THE INSTALLATION

SECTION XLVII

MOTOR DRIVEN TABLE -W

SECTION XLVII

MOTOR DRIVEN TABLE - W

MOTOR DRIVEN TABLE (W)

This table, in many respects, has its basic mechanical features identical with those of the table described in Section 50. The essential difference is that this particular model is driven by a motor actuating mechanism whereas the table in Section 50 is manually tilted from the horizontal to the vertical position and vice versa. The information contained in Section 50 regarding the installation, operation and adjustment of the mechanical parts will also apply to the motor-driven model. Information contained in this section will pertain only to the base assembly which contains the electrically motor-driven devices and their controls.

The blueprint 68-B-759, shown on the following page, is a schematic wiring diagram of the table and the reversing mechanism and the braking mechanism plus the limit switches are shown diagrammatically. As the table is energized by 110 volt, 60 cycle single phase, it is seen that by applying 110 volts across terminals 4 and 5, as shown on the blueprint, it will depend entirely upon which of the 4-pole relays is energized whether the motor will lift or lower the table. The operator foot lever pedal, which is the device that is used to raise or lower the table, is located underneath the front leg of the table proper.

The brake mechanism employs a rectified A.C. by means of a copper oxide Rectox rectifier so that D.C. may be employed to energize the brake coil, thereby eliminating 60 cycle hum, tending toward more quiet operation of this brake mechanism. The braking action is an external contracting type and the brake coil solenoid will release the brake shoes which make contact with a drum or pulley on one shaft of the driving motor. The brake is employed to reduce coasting to a minimum. The action roughly is as follows: When the operator desires to raise or lower the table by moving the manual switch under the front leg, he not only applies voltage to the motor but also applies voltage to the Rectox rectifier. The rectifier will put a rectified A.C. voltage onto the brake coil which releases the brake and allows the motor to turn. When it is desired to stop the table, taking the voltage off of the motor also de-energizes the brake coil and the brake shoes again will make contact with the brake drum. As there is very little wear on the brake shoes, it is suggested that the factory-made adjustment on this brake assembly not be tampered with unless it is definitely determined that the fault is with the brake mechanism or its adjustments. In the event that either the brake coil or the Rectox unit should fail in service, the entire assembly may be disconnected and the table operated without the braking mechanism.

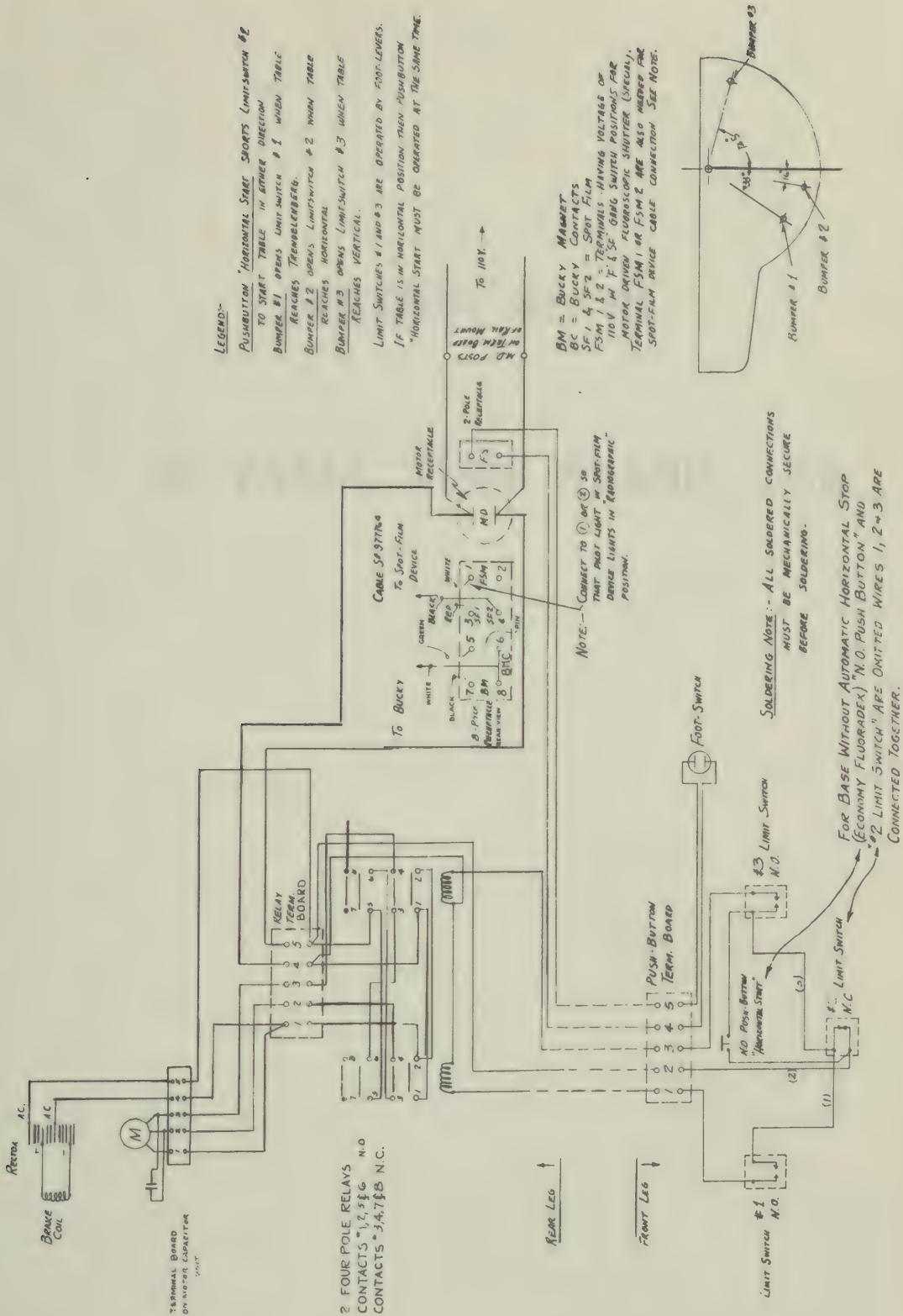
On the table body itself will be found three metal buttons or bumpers, approximately $\frac{1}{4}$ -inch in diameter, projecting out from the body of the table. These are shown in the lower right-hand corner of blueprint 68-B-759 as bumper 1, 2 and 3. These bumpers will engage limit switches 1, 2 and 3 and may require adjustment on the original installation only. The adjustment consists solely of placing washers under, or removing washers from under the bumpers so that they will engage the limit switches on the table leg assembly. Observation will show that as the table body moves from a horizontal to a vertical position, or vice versa, they will engage these limit switches and open up the circuit to one or the other of the 4-pole relays. Limit switches 1 and 3 are to prevent the table from running beyond 90 degrees in the vertical position and beyond approximately 17 degrees Trendelenberg position in the horizontal. Limit switch 2 will automatically open either of the 4-pole relays when the table has reached a horizontal position. By use of the diagram, it will be seen that the push button located at the center top of the front leg casting is a normally open push switch which, when closed, will permit the table to be moved beyond the horizontal to either the Trendelenberg or the vertical position. This is employed in the table to enable the operator to reach a horizontal plane either in a darkened room while doing fluoroscopy or have the table automatically stopped when it reaches a horizontal plane without the necessity of making constant adjustments.

MOTOR DRIVEN TABLE (W)

Some models of this table will have an 8-pole polarized plug located on the rear leg of the base assembly. Three and sometimes four wires of this 8-pole plug are from the bucky. The other 3 are intended for use with the spot film device. The motor receptacle is also located on the edge of the rear leg and a foot switch receptacle is also in this leg and, again referring to the diagram, it is seen that the foot switch plug on the front and the rear leg are connected in parallel. This permits a fluoroscopic foot switch connection to be employed on either leg.

SERVICE - As indicated previously, if the copper oxide rectifier or the brake mechanism should prove defective, it may be removed from the circuit and the table operated without the brake mechanism. The relays have a large safety margin for their contact capacity, but in the event of pitting the service may be handled in the conventional manner of sandpapering the contacts to make certain of good contact. Section 50 outlines the service recommendations in the event of mechanical difficulty with the table proper but on the motor-driven model, extreme care must be used in lining up the drive gear from the motor assembly and the gear rack on the curvature of the table body. Gears meshing too tightly will cause vibration, hum and rumble in the table body. Gears meshed too far apart will permit rattle or backlash in the table's motion. Some table models employ a condenser type motor. This is to provide an additional starting torque. The operation of the table mechanism is identical with that shown on the diagram with the exception that the condenser was connected in one of the motor leads.

MOTOR DRIVEN TABLE (W)



BLUEPRINT # 68-B-759

SECTION XLVIII

33 TABLE TUBE STAND - GE

SECTION XLVIII

23 TABLE TUBE STAND - 62

33 TABLE TUBE STAND (GE)

DIRECTIONS FOR THE ASSEMBLY AND ADJUSTMENT OF THE GENERAL ELECTRIC MODEL 33 MOTOR-DRIVEN DIAGNOSTIC X-RAY TABLES WITH OR WITHOUT POTTER BUCKY DIAPHRAGM

1. Carefully unpack the various boxes with the exception of the larger one which contains the main structure, the unpacking of which will be explained in another part of these directions. Examine all the packing material thoroughly. Do not allow any packing to be thrown away or destroyed until the apparatus is assembled and working properly.

2. Use plenty of padding material to protect the finish of the parts which will be placed on the floor during assembly. *Note:* The high tension shockproof cables will be shipped with a protective paper wrapper to preserve the finish of the cables. Do not remove this wrapper until ready for installation and do not use a knife or any other sharp instruments which will injure the finish of the cables.

3. The method described herein is believed to be the best for the work concerned and shall be followed as specified. At least one helper and at one point of the installation three helpers must be available. These directions should be read carefully before proceeding with any part of the installation in order to become acquainted with the routine of assembly.

4. **SPECIAL TOOLS** - The tools required for the installation of the table are a spirit level about 2 ft. in length and a wrench to fit a 9/16" hexagonal cap screw.

5. **PACKING** - This table is shipped dismantled into several major sections, namely, the table top complete as ordered, with or without the Potter Bucky Diaphragm; the main structural frame which includes part of the fluoroscopic carriage and counterweights; the fluoroscopic screen staging the screen mounting; the fluoroscopic tube mounting; the motor-driven unit; side members for the motor-driven unit; and the high-tension shockproof cable assemblies.

6. **ASSEMBLY** - The table assembly when complete will appear as shown in View #1. The largest and heaviest unit to be handled is the main structure, Fig. 20, with its gear sectors on each side. This main structure will be packed for shipment on a specially constructed skid, Fig. 27, View #2.

7. Before unpacking the main structure place it with the skid to the floor in the near vicinity where the table is to be installed and remove the outer packing boards and all other blocks and packing material except the skid, which is bolted to the main structure. Inspect the four bolts, Fig. 15, which hold the skid to the main structure and also observe the skid itself to see that it is not broken, especially at the point where it is bolted to the main structure. This is very important as the skid will be used in lifting, tilting and positioning of the main structure.

8. Having four strong men available, carefully turn the main structure over so that it will appear as in View #3. Padding such as used by moving companies or old pieces of carpet and boards shall be placed on the floor preliminary to turning over the main structure so that the teeth of the gear sector will rest on this material, as otherwise on a hard floor the gear teeth may become damaged, while on a soft floor the floor may be marred. The main structure is quite heavy and must be held firmly by all four men.

9. Select two of the shipping boxes which should be exactly 32" high, or if they are lower, block these boxes by means of boards so that they will be exactly 32"

33 TABLE TUBE STAND (GE)

high. If saw horses as shown in the illustration, View #4, are available, they will be more suitable but must also be of the height specified. Place the boxes or saw horses in the approximate space the table is to occupy, spacing them with their upper edges 7 ft. apart so that the main structure will just fit between.

10. Again using four men, one at each corner handle of the skid, carefully lift the skid onto the saw horses so that it will appear as shown in View #4. There should now be a space of about 4" between the lowest part of the main structure and the floor. From this point on, two men will be able to complete the installation.

11. The next step will be to place the motor-driven unit consisting of three major assemblies shown in View #1, namely the motor-driven unit proper, Fig. 18, the rear side member, Fig. 17; and the front side member, Fig. 16; including several smaller parts. Referring to View #5, remove the covers, Fig. 33, which protect the switch mechanism and fuses and then position the motor-driven unit, Fig. 18, under the main structure as shown in View #5. The foot pedals which are the front side of the motor-driven unit should be at the front side of the main structure. The front side of the main structure may be identified by being slightly higher than the rear side.

12. Block the motor-driven unit approximately 1" off the floor using the four wooden wedges supplied. Place two of the wedges, Fig. 31, near the rear side of the motor-driven unit and two near the front side as shown in View #5.

13. The rear side member, Fig. 17, which is shorter than the front side member shall be placed next, by carefully sliding it onto the rear gear sector as shown in View #5. When the rear side member is in its approximate position block up the motor unit so that the three holes in the rear side member will align with the holes in the motor unit, and the markings on the two driving gears, Fig. 29, will coincide with the markings, Fig. 28, on the large gear sectors.

14. Bolt the rear side member securely to the motor-driven unit with the three bolts provided, placing first the bolt nearest the high tension cable end of the table indicated as Fig. 32, in View #5, and then the other two bolts, one of these latter two bolts being inserted from the inside of the motor-driven unit. Be absolutely certain that the gears remain in their proper position when bolting the rear side member to the motor-driven unit. Note: If the gears should slip out of position, the rear side member must be taken off again and the gears repositioned as otherwise the table top will be twisted and the motor unit will not operate properly.

15. The front side member, Fig. 16, which may be identified by being longer than the front member, can be placed by simply bringing it straight up against the motor-driven unit and so that its rollers will properly engage the track on the large gear sector. Four bolts are provided for fastening the front side member in position, two bolts to be inserted for the front and two for the rear. Again check to see that the markings on the driving gears still correspond with the markings on the large gear sectors. Then tighten all four bolts securely. When placing the front side member it may be necessary to slightly reblock the motor-driven unit in order to have all holes align properly.

16. The table assembly has now reached a point where it is possible to remove the saw horses at the ends of the main structure. This can best be done by slightly lifting the skid first at one end and removing a saw horse and then at the other end, removing the other saw horse. The four wooden blocks under the motor-driven unit shall be removed in the same manner. The bolts which hold the skid to the main structure shall then be taken out and the skid taken off.

33 TABLE TUBE STAND (GE)

17. INSTALLING THE SHOCKPROOF CABLES ENTERING THROUGH BOTTOM OF THE TABLE - It is first necessary to determine the polarity of the high-voltage supply so that the cable ends inside the table can be properly installed.

18. The table will be furnished arranged for connection to an overhead system with the cathode side nearest the rear of the table. This layout is shown by solid lines in View #6. When it is necessary to have the cathode side nearest the front of the table, the cables shall be installed as indicated by the dotted lines in View #6.

19. Fasten the insulator Fig. 161, which has the single cord reel attached in the position shown, using the screw found in the insulator. Tighten this screw firmly but not excessively.

20. Fasten the other insulator Fig. 162, which supports the two cord reels Fig. 163, and Fig. 164, to the supporting arm Fig. 165, using the screw found in the insulator. Tighten this screw firmly but not excessively.

21. The supporting arm shall then be fastened to the rear side of the main structure, using the two screws found in position in the supporting arm.

22. Select the shockproof cable for the cathode side. This cable can be identified by the fact that it has two leads extending from the table end.

23. Remove the metal housing Fig. 168, by taking out the three machine screws which hold it in place. Next remove the two clamps Fig. 166 and Fig. 167, which support the high-voltage cables at the point where they enter the table.

24. Remove the four fillister head machine screws Fig. 169, View #9, in the connection housing Fig. 174. Connect the cord tip stamped "S" in the cathode cable to the stud "S" as shown in Fig. 170. The other lead with the cord tip stamped "L" shall be cut off and the end of the lead insulated with rubber and friction tape. When a double focus tube is used beneath the table, the lead stamped "L" is placed on the terminal stud of the cord reel which is shown in dotted lines (View #6). Three cord reels are then used.

Note: If the cables are installed in reverse order, the cathode cable shall enter the connection housing at Fig. 171. It will then be necessary to place the cord reel Fig. 163, as indicated by the dotted lines Fig. 173.

25. Replace the connection block cover Fig. 172. When doing this place the metal collar on the end of the cable in the clamp portion of the housing as shown in detail "A", View #9. Anchor securely with the four machine screws Fig. 169. The ground lead, see View #6, shall also be installed.

26. The anode cable shall now be brought into the table as shown in View #6. Insert the end of the cable in the fitting, Fig. 175, of the single cord reel support and lock it in place with the set screw found in the fittings. *Note:* This fitting can be positioned either to the right or left as shown depending upon the polarity of the high tension system.

27. Bring the anode cable along the valley of the table and clamp it in place by means of the two clamps Fig. 176 and Fig. 177. Ground the cable sheath by fastening the cord tip on the pig tail attached to the cable cone under the clamp screw.

33 TABLE TUBE STAND (GE)

28. Place the clamp, Fig. 178, over the cable and fasten it in position on the table support, Fig. 179, as shown. If the cables are installed in reverse order, this clamp must be moved over to the other side of the table support.

IMPORTANT: The arc formed by the cable between points "C" and "D" shall be uniform as there must not be any sharp bends in this cable.

29. **FLUOROSCOPIC CARRIAGE AND X-RAY TUBE** - The main carriage, Fig. 87, View #12, with its counterweight arrangement will be found already assembled into the main structure of the table, except that the counterweights, Fig. 90, one on each side of the table which have been blocked against the side of the table for shipment must be released. To release the counterweights, remove the screws, Fig. 89. Discard these screws.

30. The tracks for the counterweights and the tracks for the main carriage are fastened to the inside of the table structure with approximately eight screws each like Fig. 84. Using a large screw driver, test each one of these screws to see that they are absolutely tight as they may have become loose during shipment.

31. Try the movement of the carriage over its entire range from one end of the table to the other. Note that there are two bumper springs one at each end of the table structure which serve as cushion stops for the travel of the carriage.

32. The shutter box, Fig. 65, containing the fluoroscopic shutter shall be placed so that its rails will be guided by the four rollers, Fig. 85. Two of these rollers, namely, the ones to the right when facing the front of the table, are provided with eccentric adjustments to obtain proper clearances between the rails and the rollers. These two roller assemblies have been adjusted at the factory and unless found necessary need not be readjusted.

33. In order to place the shutter box, Fig. 65, remove the rod, Fig. 117. Place the shutter box, Fig. 65, into position and replace the rod, Fig. 117. Move the shutter box back and forth a few times to see that it rolls with ease. Two bumper springs, Fig. 88, one at each end of the carriage, serve as cushion stops for the carriage.

34. If the eccentric roller assemblies need to be readjusted, it shall be done in the following manner: Loosen the screw in the center of the exposed knurled bushing, Fig. 83, then turn this bushing until proper adjustment has been obtained and retighten the screws in the bushings.

35. If desired, the x-ray tube may be mounted onto the shutter box, Fig. 65, before placing the cross travel carriage into the main carriage. However, with the x-ray tube in position it will require some angular manipulation of the cross travel carriage and a close observation of the ends of the x-ray tube so that they will not be damaged when placing this entire unit into the main carriage, Fig. 87. A preferred method is to first place the cross travel carriage in position, then remove the large sheet metal cover, Fig. 19 View #1, and to place the x-ray tube assembly through the opening obtained by removing this cover.

CAUTION: Do not attempt to tilt the table at this point as the fluoroscopic carriage is not yet counterbalanced and the tube carriage may travel rapidly towards the ends of the table and probably damage the x-ray tube.

36. **MOUNTING OF THE X-RAY TUBE** - The fluoroscopic tube carriage will be arranged at the factory to accommodate the air-cooled XP series of Coolidge X-Ray Tubes. An XP tube when mounted will appear as shown in View #10.

33 TABLE TUBE STAND (GE)

37. After removing the x-ray tube from its crate, place it into the protective shield, Fig. 74. This shall be done in a careful manner, by removing the large collar Fig. 61, and positioning the tube in the shield so that the pin Fig. 73, will engage the slot in the threaded collar of the protective shield. Then replace the large collar Fig. 61, locking it so that the tube is held firmly in position.

38. The radiator unit is installed by slowly pushing it into the anode end of the x-ray tube and locking the knurled collar Fig. 72. Position the radiator so that the hole for receiving the cord reel cable will be facing upward when the table is in the horizontal position.

39. The tube supporting clamps will be found already mounted to the shutter box Fig. 65, or in some cases will be furnished as separate units. In the latter case, fasten these clamps to the shutter box using the two screws found in each clamp. These screws Fig. 63, must be inserted from the inside of the box.

40. Remove the metal half of the tube clamp Fig. 75, and place the x-ray tube with its window Fig. 64, facing upward and centrally located within the opening of the shutter. The cathode end of the tube shall be facing toward the foot end (the end where the double cord reel is located) of the table. Replace the clamps Fig. 75, and draw up the screws in these clamps until they hold the tube firmly, yet permitting the tube to be shifted for centering purposes.

41. Screw the cathode terminal Fig. 66, onto the threaded end of the x-ray tube. See that a small weight Fig. 92, is fastened to each one of the large weights Fig. 90, View #12.

42. CONNECTING THE CORD REEL WIRES TO THE X-RAY TUBE - Connect the wire Fig. 161, View #6, of the anode reel by hooking it directly onto the radiator of the x-ray tube. If using the x-ray tube with the large radiator it will be found that this radiator is provided with a hole for attaching the cable at both ends of the outer discs. That is, the outer disc at the extreme end of the radiator and the disc near the knurled collar which locks the radiator unit onto the x-ray tube. The anode reel hook shall be placed into the hole of the disc nearest this knurled locking collar.

43. Connect the two wires Figs. 163a and 164a, View #6 of the double cord reel one onto each post of the cathode terminal Fig. 66, which is as shown in View # 10. These two connections must be made in a careful manner so as to properly insulate these two wires from each other. First remove the cap Fig. 69, slide over the two wires Fig. 71. Then slide a length of approximately 6" of cambric tubing (spaghetti) furnished with the cathode terminal over each lead as shown in Fig. 70. Check to see that a strip of film paper is located within the inner circumference of the terminal shell.

44. Connect the tips of the leads one onto each of the terminal posts Fig. 67, and clamp in position with the screws Fig. 68. Push the two lengths of small cambric tubing (spaghetti) over the wires well up against the terminal post so that the cord reel wires will be effectively insulated from each other. The cap Fig. 69, shall now be replaced which completes the cathode terminal connections.

45. Move the entire carriage back and forth a few times to see that the cord reel wires operate satisfactorily, paying close attention to the bare portion of the cathode wires to see that they are not twisted or touch each other when placing the tube carriage in any of its possible positions.

46. TABLE TOP UNIT - POTTER BUCKY DIAPHRAGM - The 14x17 Flat Potter Bucky Diaphragm if ordered as part of this table will be furnished completely assembled into the table top unit as shown in View #13 or in some instances it will be taken out of the table top for shipment. Where the bucky is a part of the table top unit, all that is required is to ascertain that all packing material and strings have been removed and that the rollers of the counterweight are properly engaging their rails. Also examine the rollers of the bucky diaphragm to see that they too engage their rails properly.

IMPORTANT: Before proceeding with the table installation, it is advisable to determine at this time if a magnetic release and timer interlock system is a part of the installation. If the timer interlocking system and the magnetic release are to be used, read the section titled "Magnetic Release and Timer Interlock System". It will be noted that when the table is a part of an installation using a KX-8 Type 5, 6 or 7 X-Ray Unit, certain changes must be made. Therefore before installing the Bucky and Table Top make the required alterations and then proceed as described in the following paragraphs.

47. In shipments where the bucky diaphragm has been removed from the table top, it shall be replaced in the following manner: Carefully turn the table top unit upside down on a piece of padding material to protect the finish of the veneer panel; then with the counterweight unit Fig. 97 towards the left as far as it will go, set the bucky diaphragm into the table top unit as shown in View #13. The two pulley brackets, Fig. 95 must be removed from the bucky diaphragm frame. Then place the diaphragm into the table top observing the two lugs, Fig. 104, as they must be positioned under the edge of the channel alongside the table top unit in order to hold the bucky diaphragm in position when turning the table top unit right side up. After the diaphragm has been positioned replace the two pulley brackets Fig. 95, seeing that the roller attached to these brackets will properly engage the rails within the rear channel of the table top unit.

48. The counterweight unit Fig. 97, of the Potter Bucky Diaphragm will always be found assembled in the rear channel of the table top unit except that all strings and packing braces holding this weight in position must be removed and the flexible steel cables attached to this weight must be connected to the frame of the Potter Bucky Diaphragm. One end of the double cable Fig. 96, must be placed over the hook at the rear left corner of the bucky diaphragm and the other end over a hook at the front left corner of the bucky diaphragm. The longer one of the double cables shall be threaded over both pulleys Fig. 100 and 101, whereas the shorter one will only engage the double pulley Fig. 100, except that the proper groove must be selected in the double pulley so that the cable will not be twisted.

49. The single flexible steel cable Fig. 99, shall be guided over the pulley Fig. 98, and then over the hook on the right rear corner of the bucky diaphragm.

50. Carefully turn the table top unit right side up and lift it including the Potter Bucky Diaphragm onto the main structure of the table assembly, placing it so that the operating side of the bucky diaphragm is on the same side as the foot pedals of the motor unit. The lower front rollers of the bucky diaphragm are to rest on the rail Fig. 10, View #1, which will be found fastened immediately over the front side member of the main table structure. The bucky lock, Fig. 127, must be placed at this time on the rail, Fig. 10, in such a manner that the threaded stud on the end of the bucky diaphragm will engage the socket in the bucky lock Fig. 127. The threaded stud which engages the bucky lock is often bent during installation so as to lift the bucky lock off of its rail. If this is found to be the case, the threaded stud can easily be bent back to its original position. Partly insert the

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four bolts Fig. 15, two for fastening each end of the table top unit. These bolts may be placed through the openings between the table top and side members of the table structure. After placing the bolts, check to see that the Potter Bucky Diaphragm moves freely over its entire range. Then tighten the four bolts.

51. Two spacing castings Fig. 160, one at each side of the gear sector end of the table shall be fastened in their respective positions, to the end member of the table top with a screw found in position in these castings. The one from the rear differs from the one from the front, but they can easily be told apart as they will only fit into their respective positions.

52. MAGNETIC RELEASE AND TIMER INTERLOCK SWITCH FOR THE BUCKY DIAPHRAGM - If ordered as part of a Model 33 Table: The magnetic release and timer interlock switch mechanism will be found already installed in the table, except that a few parts and cables which were removed to facilitate shipment must be replaced. When used with a KX-8 Type 5, 6 or 7 X-Ray Unit certain modifications must be made in the Bucky Interlock System. For these changes refer to the section of these directions titled "Magnetic Release and Bucky Interlock System when part of a KX-8 Type 5, 6 & 7 Installation".

53. In order to simplify the installation procedure and to familiarize one with the various units constituting the magnetic release and timer interlock mechanism we are giving herewith the following outline.

54. The magnetic release proper, which releases the movement of the grid will be found assembled to the left rear corner of the bucky diaphragm.

55. A set of "make" and "break" contacts controlling the x-ray exposure as explained in the directions for the operation will be found on the left hand side of the bucky diaphragm.

56. A push-pull switch will be found at the extreme left hand front part of the bucky diaphragm. By means of this switch the entire bucky timer interlock mechanism can be turned off and the bucky diaphragm will then operate independently of the timer of the x-ray equipment.

57. A contactor board on which all wires from the magnetic release and the "make" and "break" contacts terminate shall be located below the left hand side of the bucky diaphragm carriage as explained in a latter part of these directions.

58. Contactor bars over which the contactor board slides, will be found fastened to the front part of the table structure immediately below the bucky diaphragm. A black insulated shield is placed over these parts to prevent accidental contact. DO NOT REMOVE THIS SHIELD.

59. A small terminal board at which terminates a five conductor cable from the conductor bars, will be found mounted against the inner side of the large sheet metal cover under the table.

60. The first step will be to mount the contactor board as shown in View #19. In positioning this board a little trouble may be experienced due to the fact that the contactor blades of this board must be pressed under tension, against the individual contact bars before the four screws Fig. 6, can be placed.

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61. The blades will also tend to slip between the bars when placing the board. These objectionable features, however, can easily be overcome by placing a piece of cardboard approximately 3-1/2" wide between the contact bars and the contact blades as shown in View #19, and then pressing the board into position. The cardboard must be light and tough about the same material used for postal cards. Use care not to bend or twist the individual contact blades. Remove and discard the cardboard.

62. The small terminal board Fig. 12, will be found fastened against the inner side of the large sheet metal cover under the table.

63. If it is found that this board has been removed for shipment, then fasten it in the position shown in View #19 using two screws similar to Fig. 13, but inserted from the outside of the sheet metal cover into the two threaded studs Fig. 14.

64. The five conductor cable, Fig. 15, if not found already connected, shall have its leads connected to correspondingly marked terminals on the bars Fig. 9, and on the small terminal board Fig. 12. If in doubt regarding Fig. 6 and Fig. 9 as stamped on the cable terminals, note that Fig. 6 is underlined. Except for installations with the KX-8 Type 5, 6 and 7, the two leads stamped "8" and "9" should have the cord tips taped up at the rail end and bent back and taped to the cable as shown. These two leads are not used. They should be connected at the terminal board Fig. 12, as shown.

65. The other five conductor cable, namely Fig. 11, shall have one end brought thru the cable clamp Fig. 10, and the five leads of this end shall then be connected to correspondingly marked terminals on the small terminal board.

66. When tightening the cable clamp Fig. 10, allow enough slack in this cable end so that there will be no strain on the leads connected to the terminal boards.

67. This completes the installation of the bucky release and timer interlock mechanism except that the leads at the other end of the cable Fig. 11, shall be connected to the control stand terminal board in the following manner.

68. Connect the three leads stamped "10", "15" and "115" to correspondingly marked terminals on the control stand terminal board.

69. The leads in the bucky cable stamped "RL" and "RH" are not used and should be cut off and the ends taped up.

NOTE - Be sure the link between terminals "10" and "15" on the control stand terminal board is removed.

69 A. **MAGNETIC RELEASE AND BUCKY INTERLOCK WHEN USED WITH A KX-8 TYPE 5, 6 OR 7 X-RAY UNIT** - The present three rail system for the bucky interlock system must be altered when used with any of the above x-ray units. To make these alterations the Bucky Diaphragm must be removed from the table top unit. Removal of the bucky is described in the section of these directions titled "Table Top Unit-Bucky Diaphragm".

69 B. When the bucky has been removed, install the Micro-Switch (furnished with the KX-8) on the bucky as shown in View #21. All parts are furnished.

69 C. The present three rail bucky interlock system must be changed to a five rail system, the two additional rails and contacts serving to control the bucky indicator light on the KX-8 Control Stand.

33 TABLE TUBE STAND (GE)

69 D. The two spring contacts "8" and "9" must be fastened to the sliding contact board Fig. 33, View #22 as shown using the 3/8"-8-32 binding head screws and lockwashers supplied.

69 E. Fasten the two additional rails stamped "8" and "9" (furnished with the KX-8) to the present 3 rail system inside the main body of the table. The necessary bakelite spacers are provided for a 5 rail system. Metal washers have been placed between the spacers in place of the two additional rails. To install the two rails "8" and "9" remove the nuts Fig. 42, View #16 from the three studs on the table and the similar nuts on the other two spacer assemblies. Remove the spacers and the rail stamped "6". Reassemble the spacers and the two rails "8" and "9" in the order indicated in View #22. Two 1/4" screws and nuts are furnished for terminals at the end of the rails to which the 5 wire cable Fig. 36 is attached. The leads in the cable which connect to rails "8" and "9" will be found taped up at the end of the cable. Remove the tape and connect them to the rails according to the cord tip stampings.

69 F. The three leads "A", "B" and "C", View #20, must be installed and wired into the bucky as shown. (These leads are furnished.) Install the two 1/2"-6-32 brass machine screws and nuts in the holes provided at "8" and "9" on the Bucky Terminal strip Fig. 31, View #22. The two leads 8" long and 11-1/2" long furnished with the Micro Switch shall be connected between the terminals "8" and "9" just installed and the terminals on the Micro Switch.

69 G. With the preceding changes completed, the bucky can then be installed in the table and the balance of the installation completed in the regular manner described.

69 H. The five wire bucky cable which connects at the control stand stamped 10, 15, 115, RL and RH shall be connected to the correspondingly marked terminals on the control stand terminal board except that the lead stamped "10" shall be connected to terminal "12".

70. FLUOROSCOPIC SCREEN STAGING - This screen staging, Fig. 12, View #1, and #16 will be shipped dismantled in three major units, namely the main supporting structure, Fig. 119, the screen proper, Fig. 114, and the screen supporting arm Fig. 111, with the shutter control cable attached.

71. Place the main supporting structure over the two rods Fig. 117, of the tube carriage, and fasten with the four screws, Fig. 125, found in position in these rods.

72. Fasten the control cable guide Fig. 118, to the side of the main supporting structure as shown.

73. Push the open end of the screen supporting arm, Fig. 111, over the pivot studs extending out of the main supporting structure and insert the screw Fig. 116, so that it will engage the slot in the pivot stud. Before fastening the screen proper, Fig. 114, onto the screen supporting arm, remove the screw and ornamental disc fastened to the pivot stud Fig. 115, on the screen. Insert this stud into the screen supporting arm and replace the disc and screw. Note that this end of the screen supporting arm is provided with a pin. This pin shall engage a groove near the pivot stud of the screen in order to limit the swivel movement of the screen.

74. The shutter control cable, Fig. 120, shall be guided thru the casting Fig. 118, and the fitting Fig. 121, for supporting the cable, shall be fastened to the shutter control box by means of two screws.

33 TABLE TUBE STAND (GE)

75. The two control wires extending from the end of the control cable, Fig. 120, shall be connected to their respective control levers, Fig. 122, of the shutter box by means of the screw and bushing found in place in these levers. The bakelite shield, Fig. 123, shall be fastened to the bottom of the shutter box with the two screws found in position in the shutter box.

76. The locking handle, Fig. 126, which controls both the crosswise and the lengthwise movement of the screen carriage, shall then be assembled as shown in View #17. The lock retainer, Fig. 133, slides over the locking rail, Fig. 135, and engages a pin Fig. 134, of the fluoroscopic carriage. A shorter locking rail, Fig. 136, shall be inserted in the lock retainer, Fig. 133, at right angles to the long rail and with its threaded end through a lug on the screen support. A nut, Fig. 12, two washers, Fig. 128, and an ornamental nut Fig. 127, will serve to hold this rod in position on the screen support.

77. A short plunger, Fig. 130, and a long plunger Fig. 131, shall be inserted into their respective sockets in the lock retainer after first placing the grooved ends of these plungers within the slotted openings at the ends of the locking bar, Fig. 132. Insert the handles Fig. 126, thru the crossbar into the lock retainer and then turn it to the right as far as it will go; this will lock both the crosswise and lengthwise movements of the fluoroscopic carriage. A turn of the handle to the left will release both locks.

78. IMMOBILIZATION DEVICE - The immobilization device, Fig. 9, View #1, shall be installed as follows: Slide the brackets over the rails on each side of the table top unit as shown in View #1. These rails have a cut away section to permit placing of the two brackets. Pull the cloth across the table top and insert the rod in the slotted opening of the rear bracket.

79. COMBINATION FOOT AND HEAD REST - The combination foot and head rest as shown in Fig. 14, View #1, can be placed by simply pulling up on the two knobs, Fig. 13. Insert the prongs of the head rest into corresponding holes of the table top unit and then release the two knobs Fig. 13, which will lock the unit in position.

80. CONNECTION TO POWER - The table assembly has now progressed far enough to connect the motor-driven unit to its power supply; a connection box for making the necessary connections is located under the cover, Fig. 33, View #5, and after the cover has been removed will appear as shown in View #15.

81. It is recommended that the supply wires which should be at least #14 for a distance up to 200 ft. be run in metal conduit to a point beneath the table, and from there to a flexible metal conduit to the connection box itself at the rear side of the motor driven unit. Provision has been made for the use of this type of conduit. For distances over 200 ft., heavier gauges of wire must be used.

82. If it is necessary to use a connection cord, it is recommended that some one of the heavily insulated rubber covered cables such as Tyrex be selected.

83. The power supply should be within ± 10 volts of that stamped on the motor nameplate which is 230V A.C. It is necessary to supply the motor with a frequency as stamped on the nameplate. Therefore at rated frequency 60, 50, 40, 30 or 25 cycles per second, the voltage range shall be 220 to 240 volts.

84. With the voltage constant at 230 volts, variations in frequency are permissible. At 230 volts, a motor rated at:-

33 TABLE TUBE STAND (GE)

60 cycles/sec. will operate on 54-66 cycles/sec.
50 cycles/sec. will operate on 45-55 cycles/sec.
40 cycles/sec. will operate on 36-44 cycles/sec.
30 cycles/sec. will operate on 27-33 cycles/sec.
25 cycles/sec. will operate on 23-27 cycles/sec.

85. 220V. A.C. SERVICE CONNECTIONS - On a 115/230 volt Edison three-wire system, connect motor across outside wires.

86. On a 230/460 volt Edison three-wire system, connect motor to center and either outside wire.

87. On a 400 Y-connected system, connect motor to phase wire and grounded center wire.

88. On a 230 volt three-phase system, connect motor to any two wires.

89. Where 230 volts A.C. is not available, the required 230 volt supply can be obtained from standard General Electric X-Ray Corporation control stands.

90. LEVELLING - Each table has been completely set up and tested in the factory for quietness and perfect operation. To insure these same qualities after the table has been shipped and installed proper levelling of the table is required. It is not necessary that the table be absolutely level as sometimes a table will work better when it is not level.

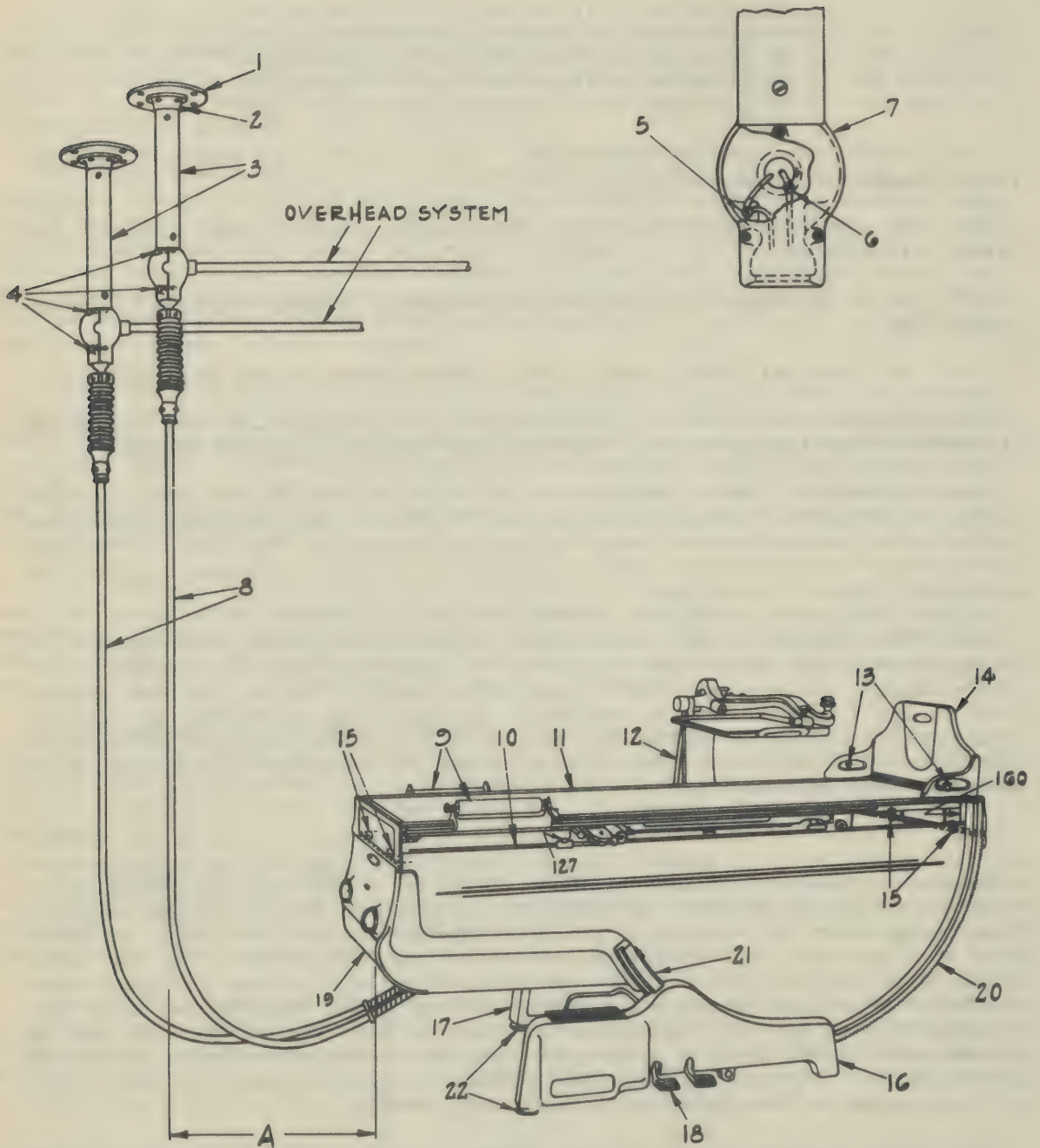
91. The procedure to be followed shall be to level the table which can best be accomplished by moving the table top until the opening of the front member is directly opposite the zero mark on the angle scale Fig. 21, View #1, and then using a level on the table top itself, adjusting the levelling screws Fig. 22, View #1 (there are two of these), on the motor-driven unit until the table top is level, in all directions. With very uneven floors it may be necessary to use metal shims under the motor-driven unit at the gear sector end.

92. If after the table has been levelled the operation of same is not uniform and quiet, that is, if it appears that the table seems to be working under a strain in certain sections of its range, then the tightening of all bolts has not been performed uniformly in order to bring the table assembly back to its original setting. This, however, can be compensated for by loosening, one half turn only, the three bolts for fastening the rear side member to the motor-driven unit, the four bolts holding the front side member against the motor-driven unit and the four bolts holding the table top unit to the main structure. After all of the bolts mentioned have been loosened one half turn only, place a patient on the table and move the table by its own power several times to vertical and back to horizontal position. Remove the patient and tighten all bolts gradually about one quarter turn at a time. This will improve an incorrectly operating table considerably.

93. As mentioned before, it is not always advisable to have the table placed perfectly level. Slightly adjusting the levelling screws while the table is being operated over the range in which the table is noisy will change conditions. Always bear in mind that only by fine adjustment, uniform tightening of all bolts and proper footing or levelling, it is possible to obtain the quietness in operation which is part of this table.

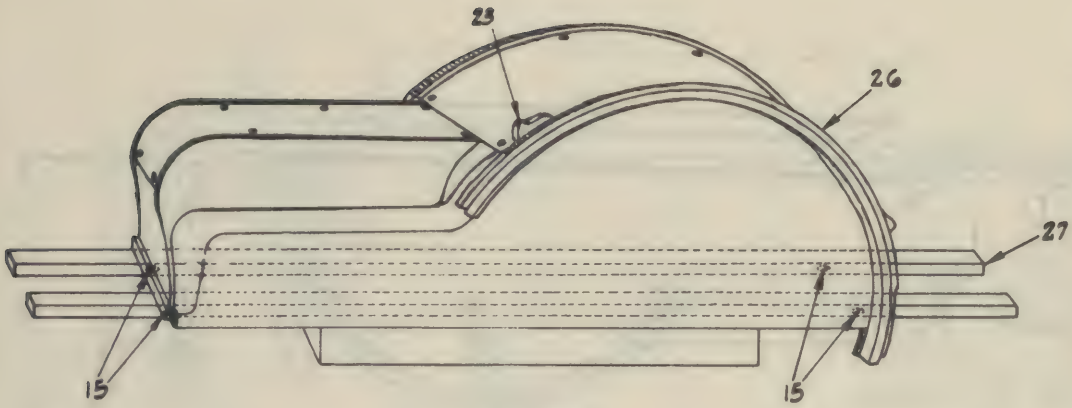
94. After the table operates satisfactorily, screw the cover plates Fig. 33, View #5, in position.

33 TABLE TUBE STAND (GE)

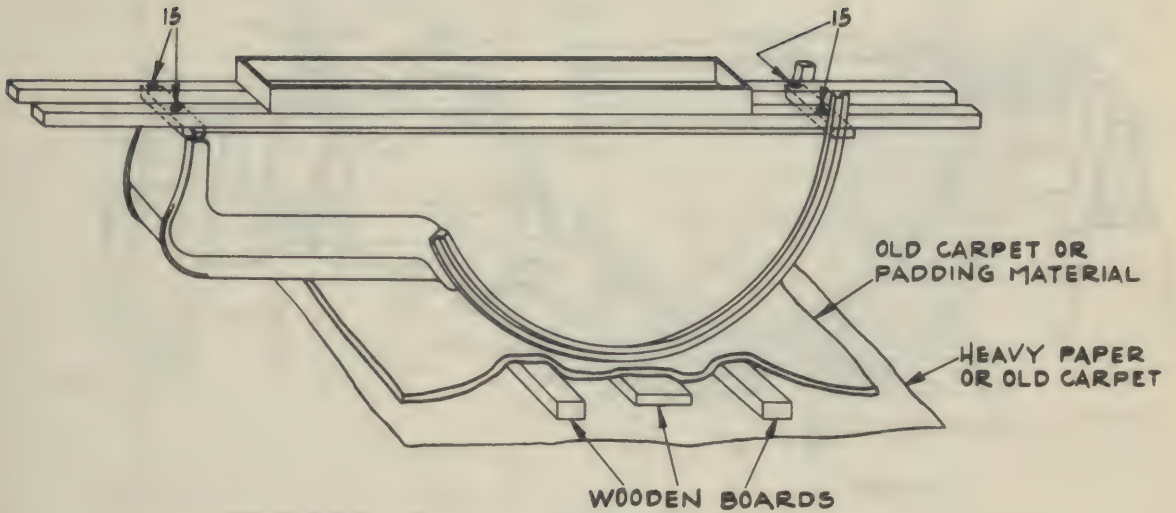


VIEW #1

33 TABLE TUBE STAND (GE)

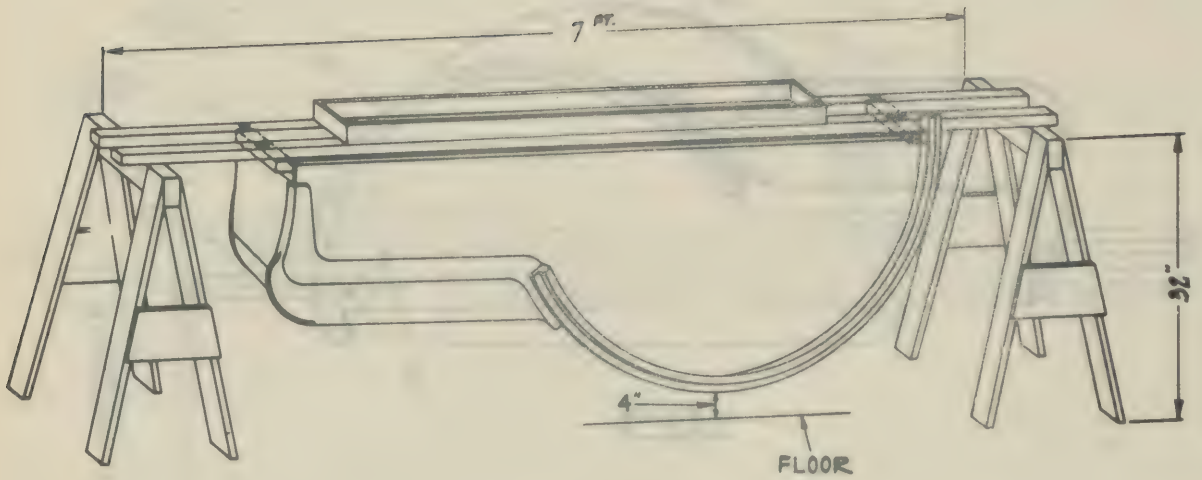


VIEW #2

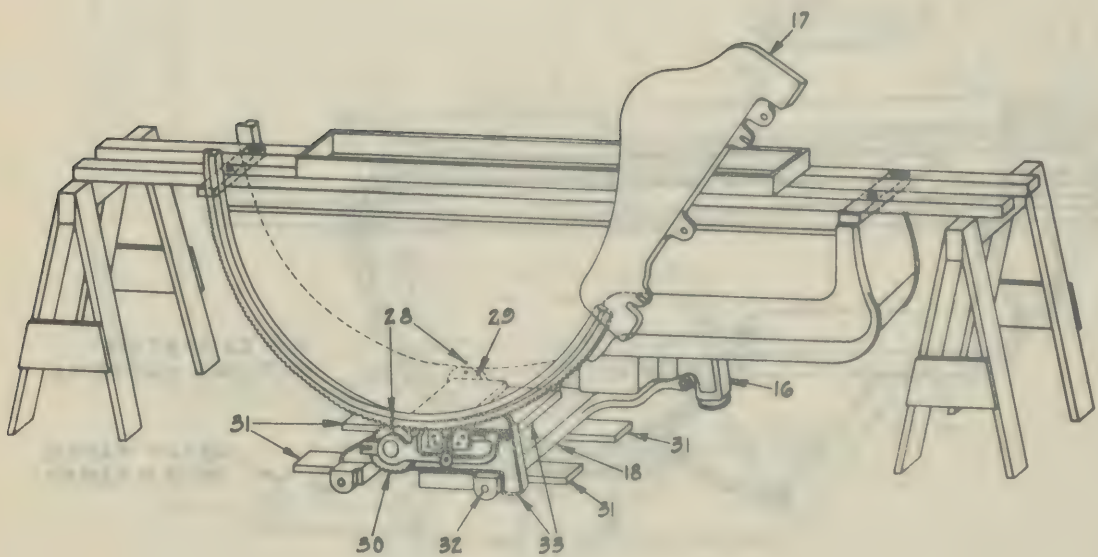


VIEW #3
FRONT VIEW OF TABLE

33 TABLE TUBE STAND (GE)

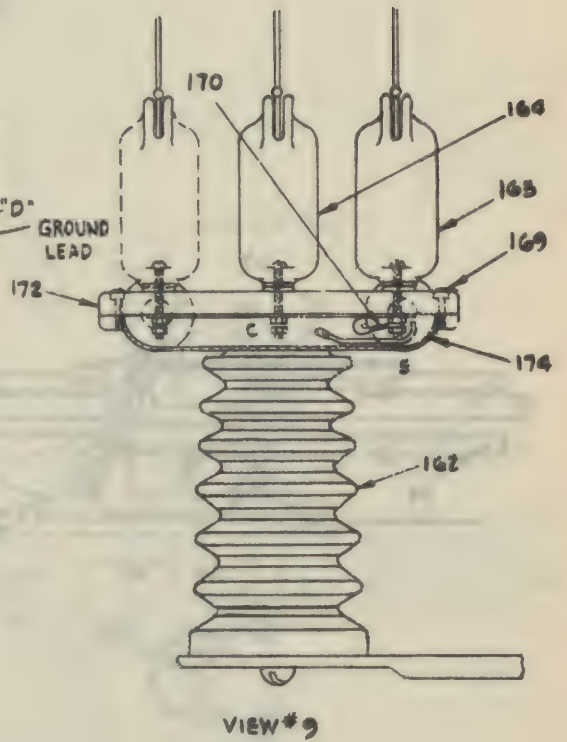
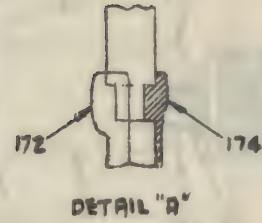
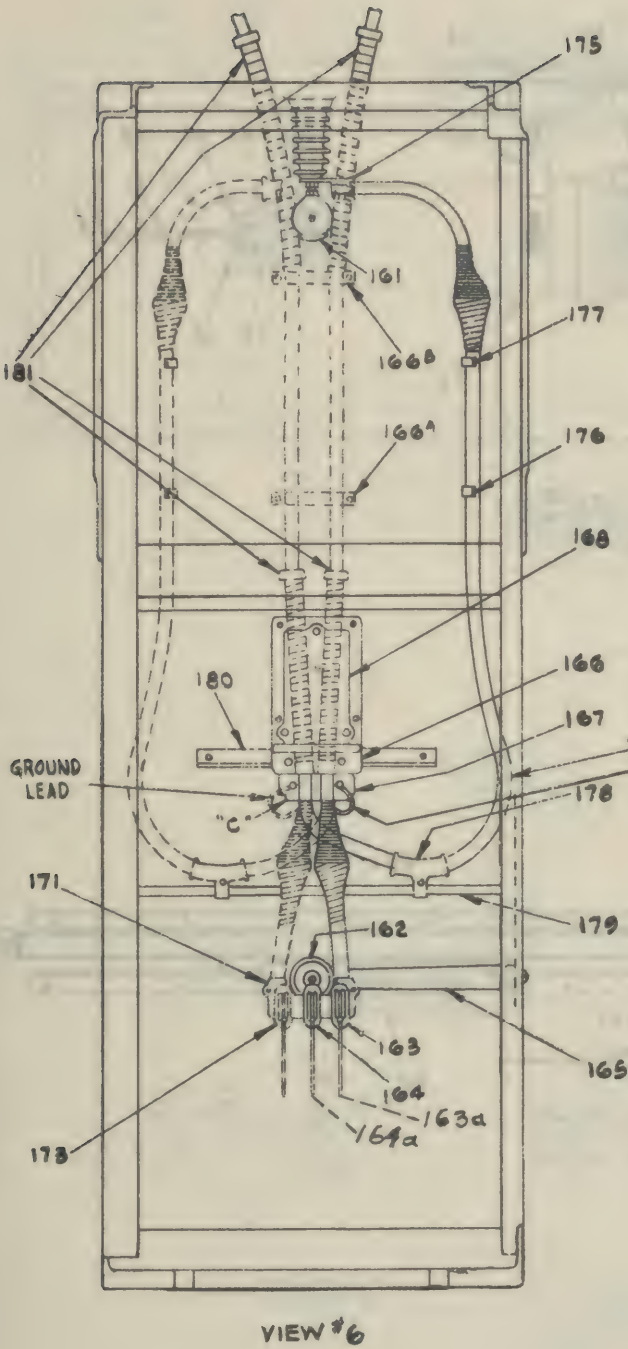


VIEW #4
FRONT VIEW OF TABLE

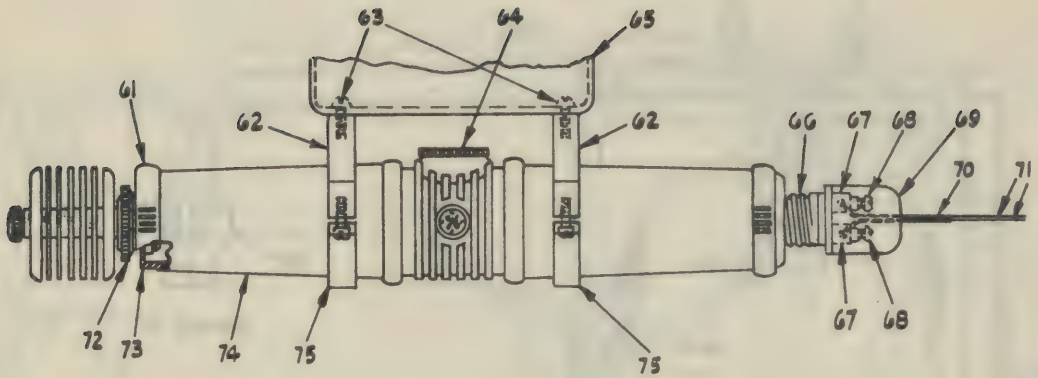


VIEW #5
REAR VIEW OF TABLE

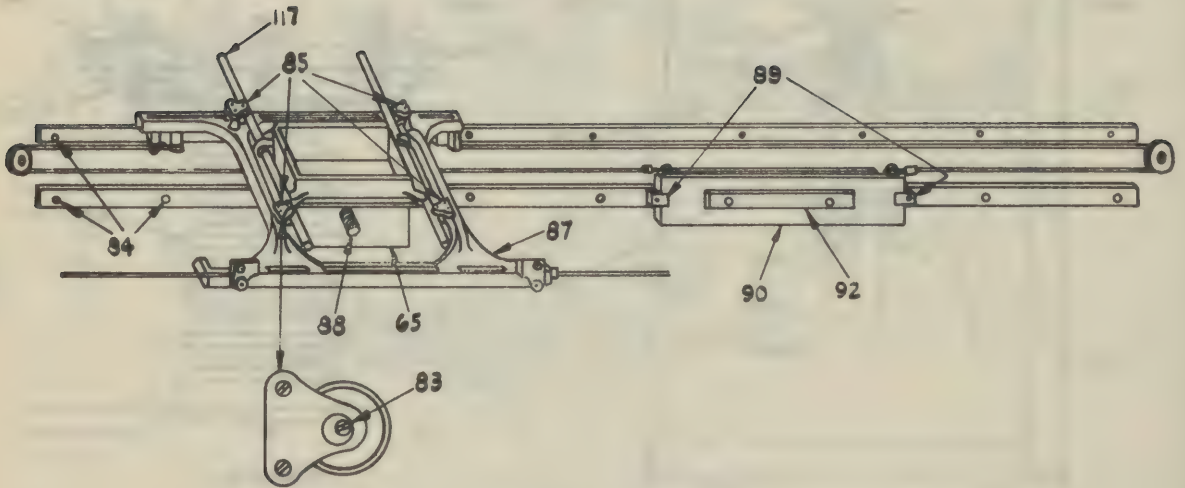
33 TABLE TUBE STAND (GE)



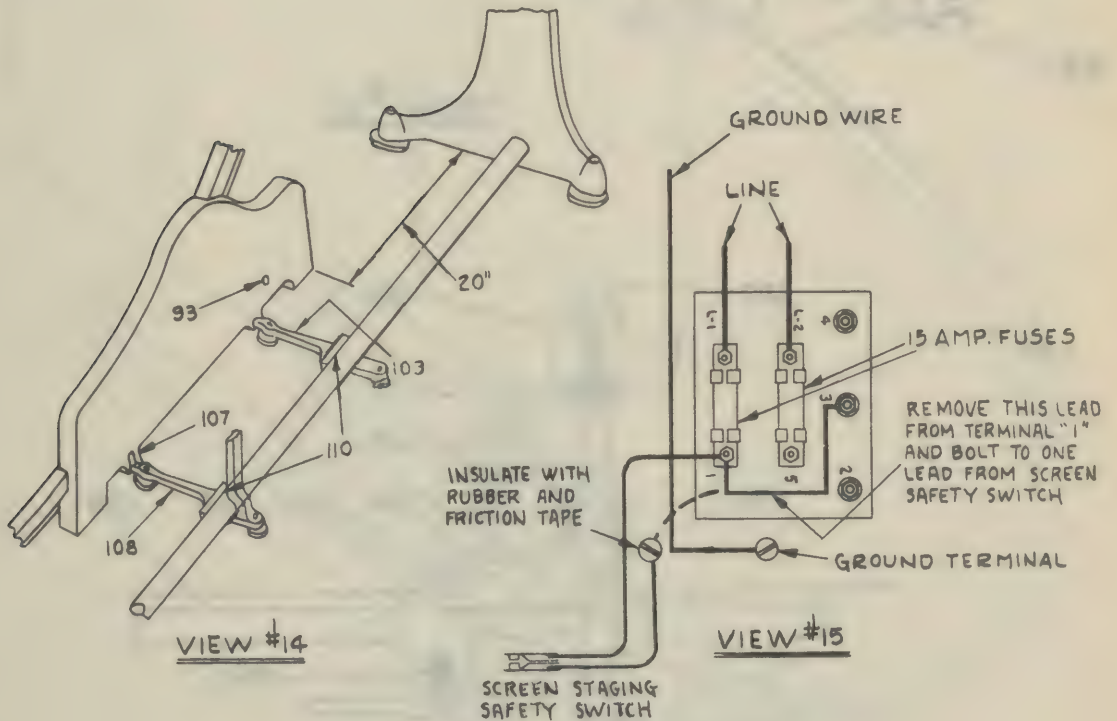
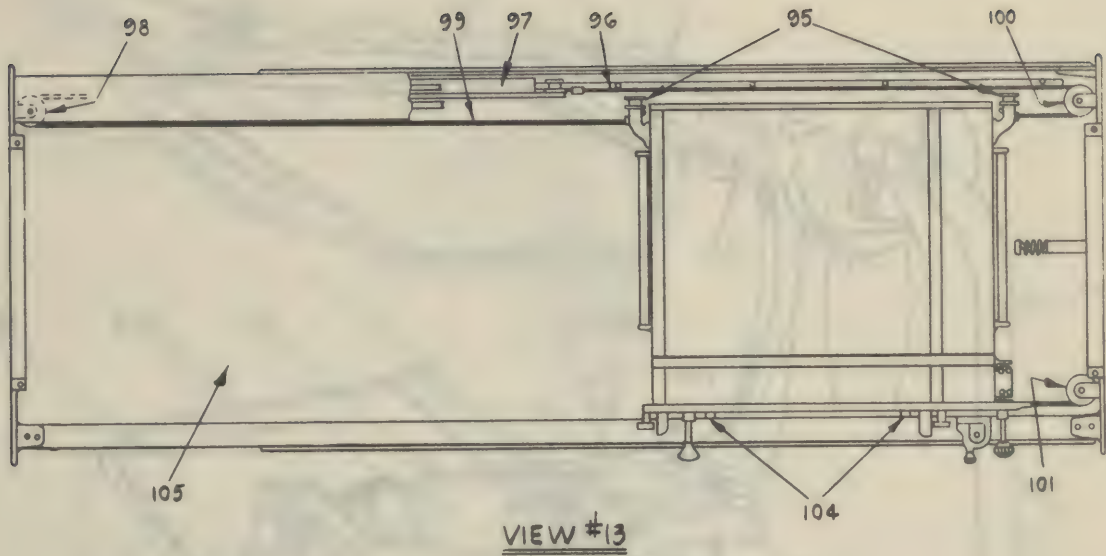
33 TABLE TUBE STAND (GE)



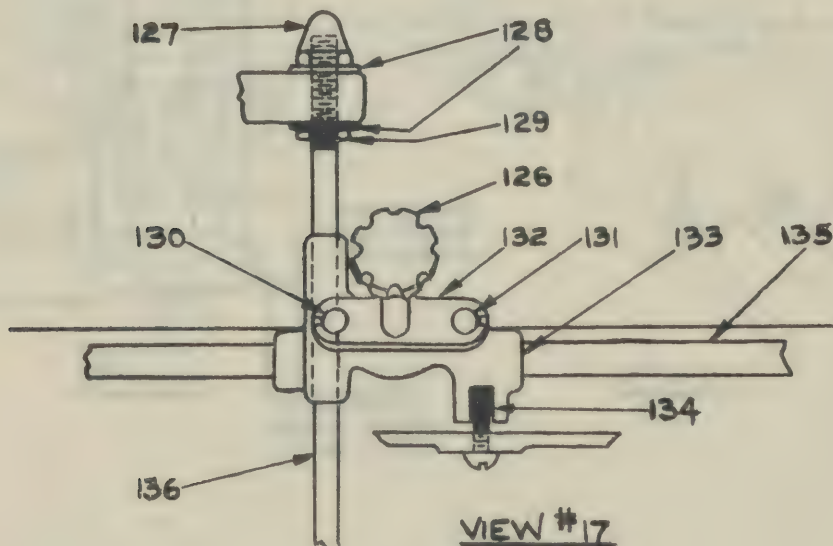
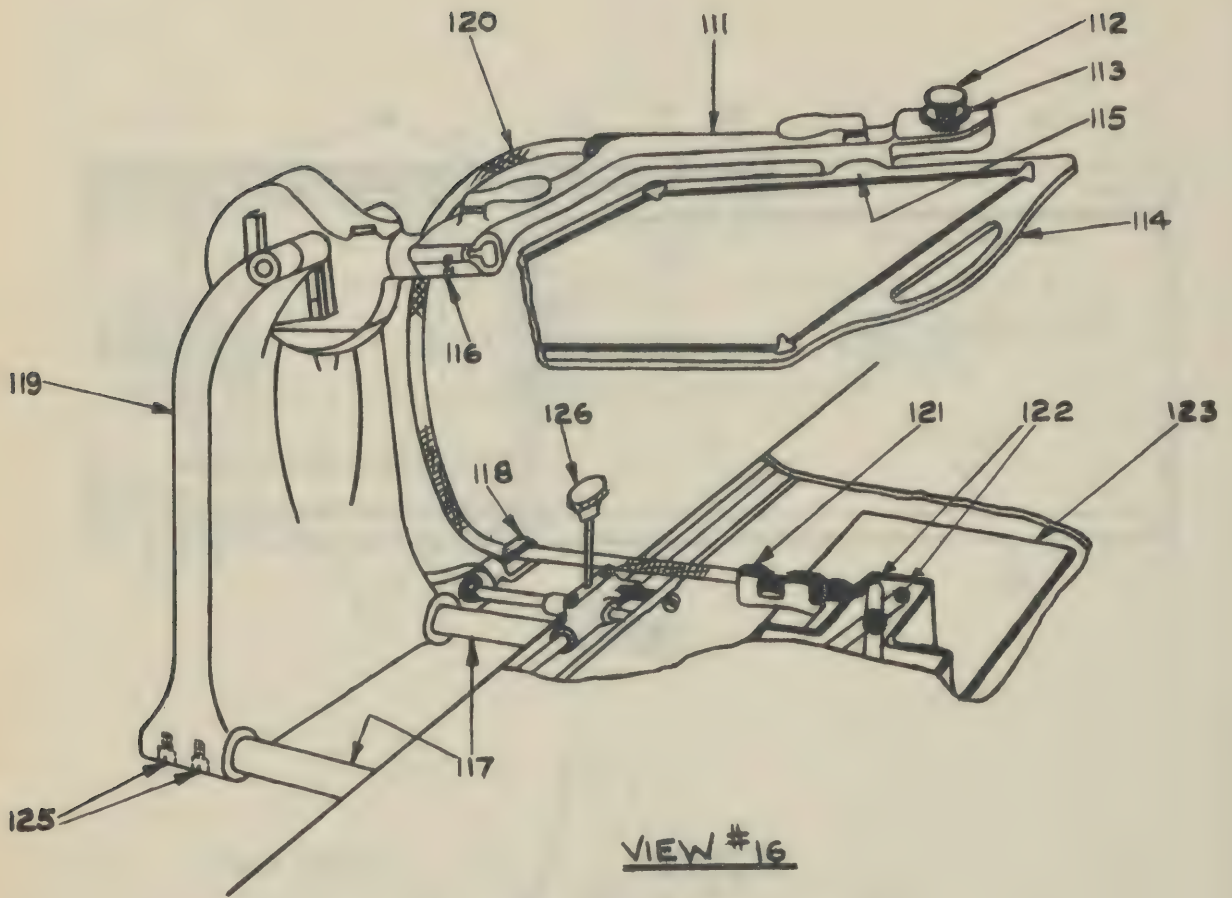
VIEW #10

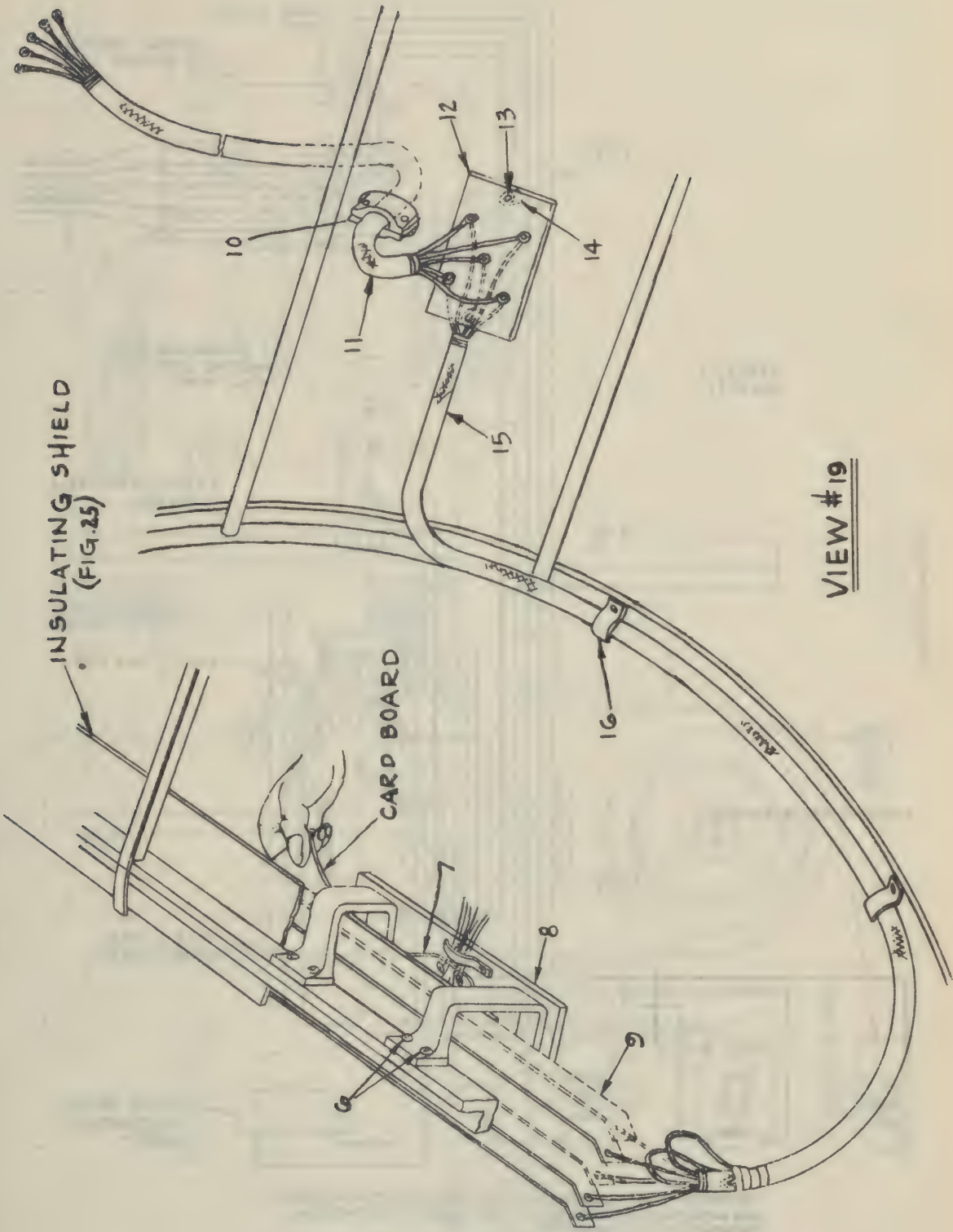


33 TABLE TUEE STAND (GE)



33 TABLE TUBE STAND (GE)





VIEW #19

33 TABLE TUBE STAND (GE)

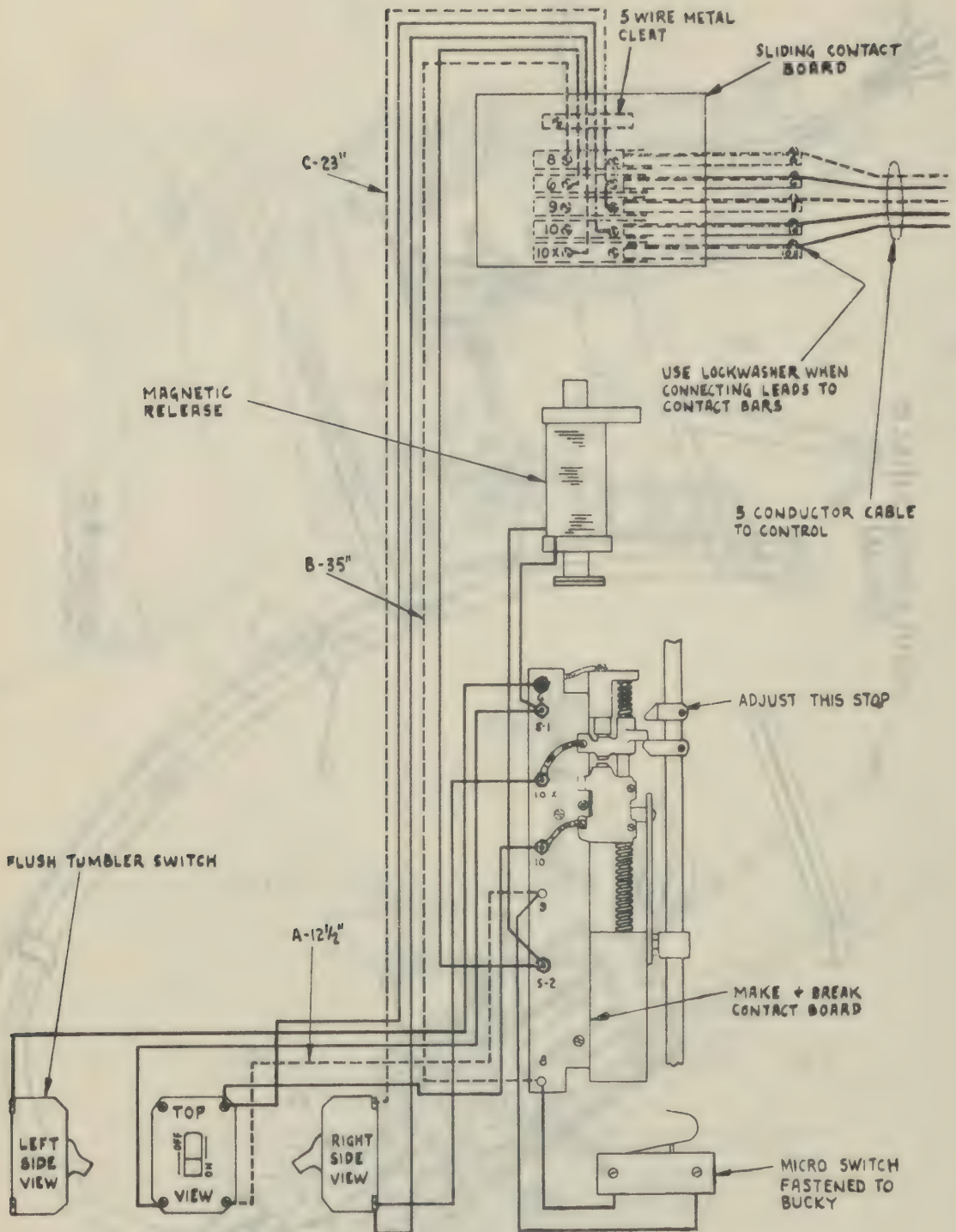
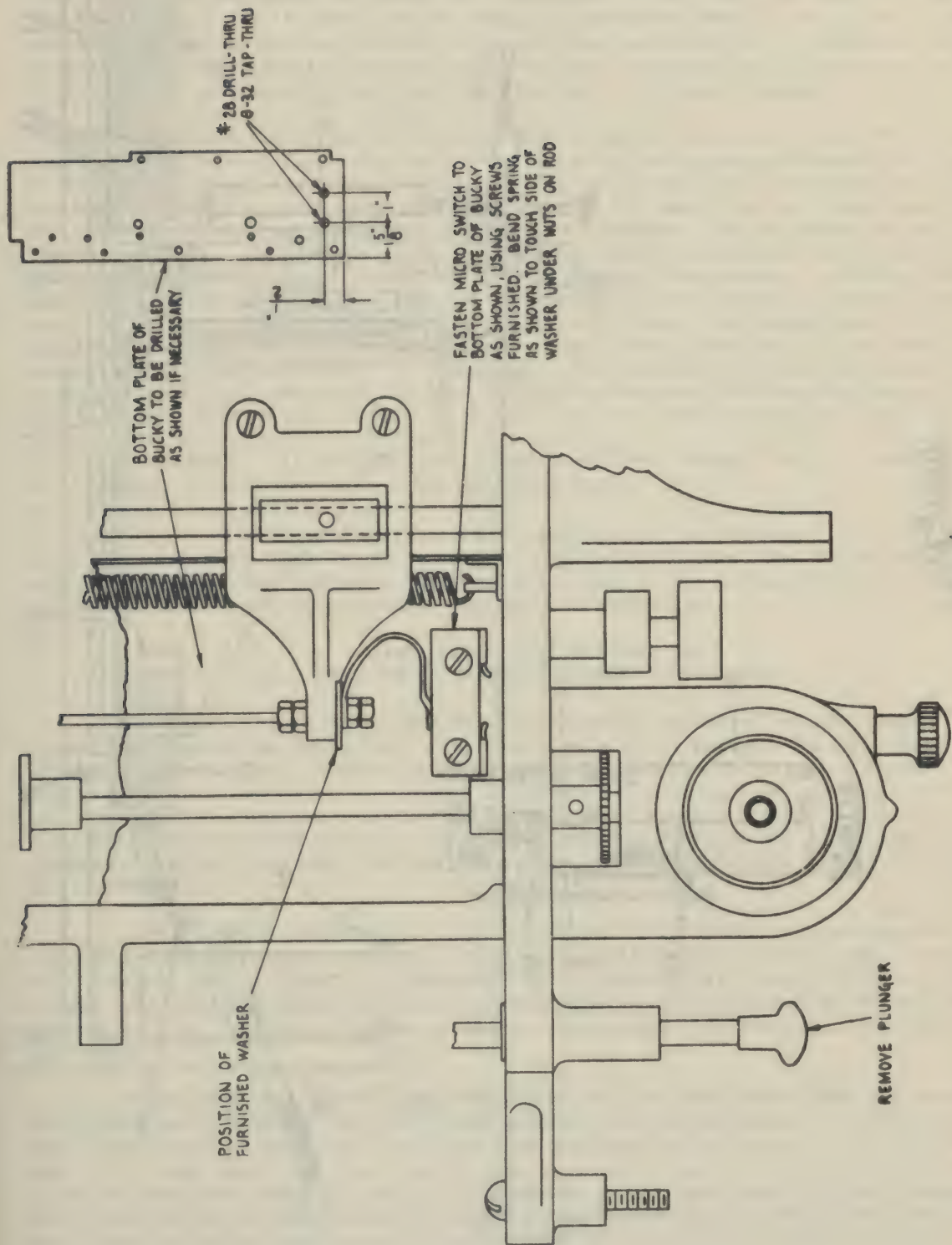
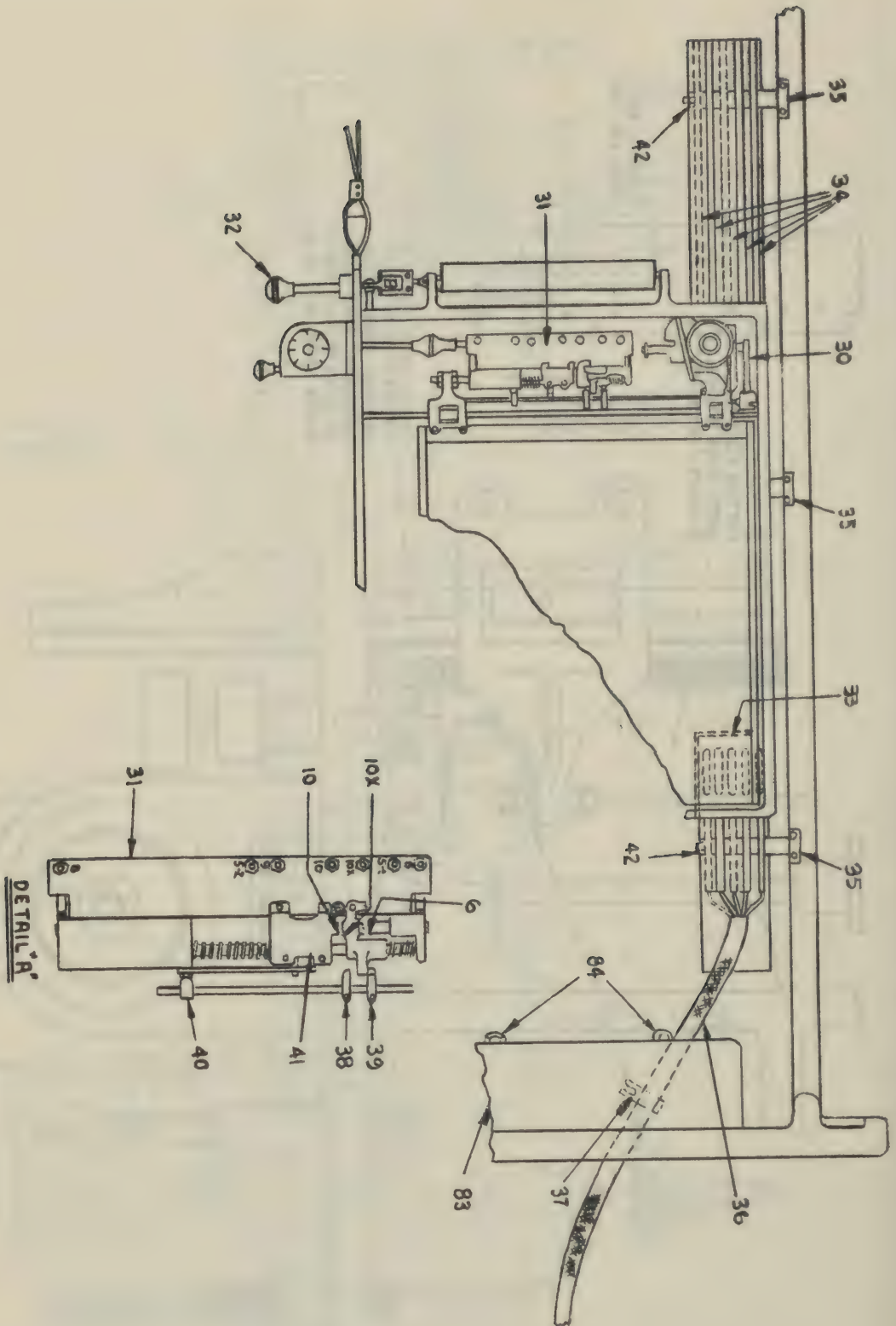


DIAGRAM OF CONNECTIONS FOR THE MAGNETIC RELEASE
AND INTERLOCK SYSTEM FOR THE BUCKY DIAPHRAGM
SHOWING SWITCH CONNECTIONS
VIEW # 20



VIEW #21

VIEW # 22



33 TABLE TUBE STAND (GE)

95. ADJUSTMENTS - No adjustments will be needed in the field. The automatic stops are adjusted at the factory and the brake is self-adjusting. Outside of these points no adjustment is possible or necessary. Note that the stop as shown in Fig. 23, View #2, is the one used for the hand operating tables. The stops for the motor-driven tables are in the shape of round pins, one of which is riveted into the approximate space where the stop bracket, Fig. 23, is shown, and the other of which is riveted in position at the other extreme end of the gear sector.

96. The centering of the tube with relation to the image cast upon the fluoroscopic screen is very important, and therefore cannot be a matter of guess, but must be done under actual operating conditions. Bring the table in its vertical position and position the fluoroscopic screen approximately 12" away from the table top. Open the shutters as wide as possible if the table is equipped with an automatic shutter limiting device. If the table does not have a shutter limiting device open the shutters so that the image covers almost the entire screen area. In either case, the image should be centrally located within the borders of the screen. If not, turn the machine off and shift the tube to correct this. The image moves in a direction opposite to the movement of the tube and a slight movement of the tube will cause a relatively large shift of the image. This procedure is repeated until the desired results are obtained. Be sure to tighten the screw holding the clamp, Fig. 75, View #10, upon obtaining correct position of the tube to prevent slippage.

97. GROUNDING - It is highly essential that these tables, being of shockproof construction, be well grounded in the following manner:-

98. Run a wire of at least size #10, preferably, in the same conduit as the power supply, connecting it at one end to a permanent ground such as a cold water pipe, and at the other end under the ground terminal in the connection box, View #5, in the motor-driven unit. *DO NOT GROUND TO A GAS PIPE.*

DIRECTIONS FOR INSTALLING THE VERTICAL STEROSCOPIC SHIFTING DEVICE

1. The installation of the vertical stereo-shifting device is very simple providing the routine as described herein is carefully followed. The illustrations following show the parts comprising the stereo-shifting device in solid lines. All shifting devices have been completely assembled and adjusted under actual working conditions before they leave the factory. All that is required of the one installing this unit is to follow these instructions step-by-step and the fine factory adjustments will be retained. We urge that these directions be read before beginning the installation.

2. INSTALLATION ON MODELS 22, 30, 31 AND 40 TUBE STANDS - To compensate for the additional weight of the stereo-shifter, a small weight unit Fig. 15, approximately 4-1/4" long x 2-5/8" in diameter will be furnished with every shifter. This weight unit must be placed over the rod Fig. 24, in addition to any other weight unit which will be required in accordance with the instructions accompanying the tube stand.

3. Where the tube stand is already installed, the tube stand must be removed from its mounting before the additional weight unit can be placed. To remove the tube stand from its mounting, raise the tube carriage as far up as it will go locking it in that position, then remove the carriage from its vertical supporting sleeve at the point where it swivels. Loosening the two set screws in the hexagonal lock screw of the swivel stud will permit removal of this nut. Note the order and position in which the washers which are held by this nut will be found, so that they

33 TABLE TUBE STAND (GE)

are later replaced in their proper order. Then carefully pull the tube carriage off the swivel stud. The total weight of the tube stand has now been sufficiently reduced, so that it may be lifted out of its mountings and slowly placed in a horizontal position. With the tube column in its horizontal position, loosen the set screw in the lower nut Fig. 26, and remove the nut. Slide the additional weight unit on the rod Fig. 24, and replace the washer Fig. 25, and the nut Fig. 26, locking the set screw in this nut securely. Replace the tube stand column in its mountings firmly tightening all bolts and clamps. Replace the tube carriage over the swivel stud. Replace the fibre then the steel and finally the two cup-shaped spring washers with their convex surfaces to the outside over the swivel stud. Replace the nut and tighten it to obtain the desired friction, then lock the set screws in this nut firmly.

4. To install the stereo-shifter, mount the supporting bracket Fig. 1, onto the pulley cap of the tube stand by means of the three screws furnished. Guide the bar Fig. 2, through an opening in the turn table support Fig. 8. Fasten the bar with its upper end onto the support bracket Fig. 1, and with its lower end onto the lug of the stop collar Fig. 14. Then clamp the stop collar into position.

Note: Where the tube stand is mounted on a Universal side rail unit, the lower end of the bar will be fastened onto the upper rail attachment of the Universal side rail unit, thus eliminating the stop collar in installations of this kind.

5. After the bar has been fastened into position, check the distance between the bar Fig. 2, and the rail on the column Fig. 16, at several points over its length in order to determine whether the bar runs parallel with the tube columns. Variations up to $1/32$ " are permissible. If the variations exceed approximately $1/32$ ", then the bar must be shimmed slightly to face "A" of the clamping collar or at face "B" of the supporting bracket until the bar is positioned parallel with the rail or the tube stand column.

6. To place the stereo mechanism pull the toothed rod Fig. 10, into its "Cocked" position which is the position shown, then remove the screw Fig. 18, and its two steel washers Fig. 17, and place them aside. Remove the bearing plate Fig. 13, from the shifting mechanism, noting its exact position, and loosen the thumbscrew Fig. 9.

7. Place one of the steel washers Fig. 17, into the socket Fig. 22, of the turn table support, then place the entire shifting mechanism so that the end of the toothed rod will locate itself over the steel washer Fig. 17, and the bearing bracket Fig. 12, will engage the bar Fig. 2. Replace the bearing plate Fig. 13, locking it firmly into position.

8. Through a hole in the turn table support, replace the stud Fig. 18, and the second steel washer Fig. 17. When locking this stud into position, it will be noted that the toothed rod Fig. 10, is free to move slightly within its socket. This so-called floating of the toothed rod is desired and no attempt should be made to eliminate it.

9. **TESTING AND OPERATION OF THE STEREO-SHIFTER - NOTE:** The following procedure for testing and operating the Stereo-Shifter applies to all Model Tube Stands. Refer to Illustration 1.

10. With the Stereo-Shifter in its "cooked" position, place the tube carriage at any desired height locking it in position by means of the thumbscrew Fig. 9. The handle Fig. 20, must be completely released. Pull out the knob Fig. 6, and turn

33 TABLE TUBE STAND (GE)

the dial by means of this knob, setting it so that the indicator Fig. 3, will be directly opposite "5" on the dial. Release the knob so that it will engage the hole for this setting. A slight clicking noise will indicate that the plunger has properly engaged this hole. Now pull the string Fig. 7. This will release the tube carriage for a travel of 6", which is the corresponding shift for a target to film distance of 5 feet.

11. The dial Fig. 5, as will be noted is calibrated in focal film distances instead of actual shifts. This eliminates the necessity for the operator to calculate what shifts should be used for any given focal film distance. The dial is calibrated for focal film distances of 4, 5, 6, 7 and 8 feet and is arranged so that the tube shifts 1.2" per foot focal film distance. Thus for a 5 foot focal film distance, the actual tube shift is 6".

12. The numerals on the index scale Fig. 19, on the tube carriage which are 4, 5, 6, 7 and 8 are for the purpose of centering the tube to the film for stereoscopic work, taking into consideration the actual shift of the tube, but also calibrated in terms of focal film distance rather than shift distance. The height scale on the cassette changer is set to correspond with the height scale on the tube stand. This shall be done in the following manner: Set the arrow marked "Table Top" of the index scale Fig. 19, opposite "28" on the tube column scale Fig. 21, and lock the tube carriage in this position. With the x-ray tube carriage turned to face the cassette changer, measure the distance from the floor to the center of changer, measure the distance from the floor to the center or target of the x-ray tube. Then raise or lower the cassette changer so that the distance from the center of the cassette changer panel to the floor will be the same as the distance just measured at the tube stand. Keep the cassette changer in this position and move the height scale of the cassette changer so that 28 on the cassette changer height scale will be directly opposite the indicator on the cassette changer. This will accurately center the x-ray tube to the cassette changer for all other settings.

13. To illustrate the use of the index scale Fig. 19, let us assume that for a given patient the cassette changer scale indicates a height of 24" and that the focal film distance is 5 feet. In this case, the numeral 5 on the index scale Fig. 19, will be set opposite 24 on the tube column scale Fig. 21, and the dial on the stereoscopic shifter must be set at 5. **IMPORTANT: ALWAYS HAVE THE STEREO-SHIFTER IN ITS "COCKED" POSITION WHEN CHANGING FROM ONE DIAL SETTING TO ANOTHER.** Make the above mentioned example setting and release the shifter by pulling the string Fig. 7, or if the shifter is equipped with a magnetic trip by pushing the release button. The carriage should travel upward 6". Thus the line at 5 on the scale Fig. 19, should travel from its original position opposite 24 on the tube column scale to 30 on the tube column scale. If it does, reset and release the shifter several times to see that the shifter will travel consistently the same distance. If the travel is short of 6", then turn the thumbscrew Fig. 4, in a clockwise direction until satisfactory operation has been obtained. Turning the thumbscrew in a counter clockwise direction will shorten the travel of the tube carriage. The thumbscrew should be so adjusted that the shifter will come to rest when the face "C" of the shifter is approximately 1/4" away from the rubber cushion Fig. 11. **DO NOT PULL THE TUBE CARRIAGE DOWN VIOLENTLY.** Use just enough effort to bring the tube carriage to its resting position which will give about 1/16" space at "D". For a 7 or 8 foot shift do not set the tube carriage higher than 31", for a 6 foot shift not higher than 32", or for a 4 or 5 foot shift not higher than 33".

14. **CAUTION:** - When turning the thumbscrew Fig. 4, in a counter clockwise direction, extreme care must be exercised so as not to turn it too far. If the thumb-

33 TABLE TUBE STAND (GE)

screw will move outward, denoting that the pressure is completely released, then do not turn further in the same direction as a spring catch within the adjusting mechanism will be released and a factory adjustment made necessary.

15. COUNTERBALANCING OF TUBE CARRIAGE - The counterbalancing of the tube carriage is properly explained in the directions accompanying the tube stand. In some cases it may be necessary to slightly increase the weight within the weight pocket Fig. 43, due to an exceptionally strong pull of the cord reel connection cables, because certain makes of cord reels are provided with exceptionally strong springs. This pull of the cord reel cables will act as a lift when operating the stereo-shifter. This lift is not desired as it may increase the speed of the shifter to an extent where it will prevent smooth braking action and therefore should be counteracted by placing additional weight units into the pocket Fig. 43.

16. INSTALLATION OF VERTICAL STEREO-SHIFTING DEVICE ON MODEL 33 OR 44 TUBE STANDS - Refer to Illustration 2. Using the machine screws which are furnished, mount the guide bar Fig. 36, on the tube column, securing it at points E and F, as shown in Illustration 2.

17. Check the distance between the guide bar Fig. 36, and the rail Fig. 29, at several points to determine if the bar is parallel with the tube column. If it does not vary more than $1/32"$ it will be satisfactory. If however, the variation exceeds $1/32"$, the guide bar must be shimmed at either point E or F to bring it into the correct position.

18. NOTE - If the Model 33 or 44 Stand has been installed without the stereo-shifting device, a counterweight assembly will be found mounted on the right hand side of the column in the same manner as the left counterweight assembly Fig. 46. This must be removed, so that the stereo-shifter can be installed in its place.

19. To mount the stereo-shifter, first pull the toothed rod Fig. 39, into the "cocked" position (as shown). Remove the screw Fig. 44, and the washers Fig. 48, and lay them aside. Next remove the bearing plate Fig. 42, from the stereo-shifter. Loosen the thumbscrew Fig. 45.

20. Insert the machine screw Fig. 44, through the bracket Fig. 49, with the washers as shown.

21. Place the entire stereo-shifting mechanism in position on the column, so that the toothed rod is over the hole in the bracket Fig. 49, and so that the bearing bracket Fig. 40, will engage the guide bar. Tighten the screw Fig. 44. Now place the bearing plate Fig. 42, in position and secure it in place with the four machine screws provided. Fasten the counterweight Fig. 41, to the stud on the bearing plate with the screw Fig. 47.

22. NOTE - A slight play between the toothed rod and the bracket may be noticed; however, this is desirable and no attempt should be made to eliminate it.

23. INSTALLING VERTICAL STEREO-SHIFTING DEVICE ON THE MODEL 43 TUBE STAND - When the vertical stereo-shifter is furnished with a tube stand from the factory, the counterweight Fig. 60, Illustration 3, is installed in the tube stand column at the factory.

24. When the stereo device is shipped for installation on a stand already installed in the field, it will be necessary for the serviceman to install the counterweight when the stereo-shifter is installed.

33 TABLE TUBE STAND (GE)

25. The tube stand must be removed from the side rail unit. First remove the horizontal carriage which supports the tube unit, at the swivel bearing on the vertical carriage.

26. Slide the vertical carriage to the top of the tube stand and lock it in position.

27. Remove the stand from the brackets on the side rail unit and place the stand in a horizontal position.

28. Loosen the counterweight cable at the fitting on the vertical carriage and carefully slide out the counterweight assembly.

29. Install the stereo counterweight as shown in Illustration #3. Reassemble the tube stand on the side rail unit.

30. INSTALLING THE STEREO DEVICE - Using the flat head screws furnished, fasten the casting Fig. 52, Illustration #3 on the top casting of the tube stand.

31. Remove the rear half of the casting Fig. 64, and replace it with the casting Fig. 54, which is furnished.

32. Fasten the bar Fig. 51, in position as shown using the machine screws furnished.

33. Remove the bar Fig. 65 on the stereo bracket which is held by two machine screws as shown.

34. With the stereo mechanism in its "cocked" position, place the stereo-shifter assembly on the vertical carriage casting and fasten the bar Fig. 65 in place. Note that a washer Fig. 67 is placed on each side of the casting. Insert the screw Fig. 57 into the toothed rod Fig. 56 and tighten the screw in place securely.

35. It will be noted that the toothed rod is free to move slightly within its socket. This so called floating is desired, and no attempt should be made to eliminate it.

36. The operation of the stereo-shifter is the same as described in the foregoing part of these directions.

G-E MODEL 33 DIAGNOSTIC X-RAY TABLE

DESCRIPTION - In order that the operation and maintenance of this Model 33 Diagnostic X-Ray Table may be more thoroughly understood, each component part is described both as to purpose and as to manipulation; the parts referred to are in each case identified in the illustration.

The Model 33 Table is available with either a motor-driven or manually-operated elevating mechanism. Either model is available with or without certain accessories and, with the exception of the difference in the elevating mechanism, both are identical.

These instructions cover both models in all combinations. The reader should disregard any reference to any facilities which may not be included with his particular table.

33 TABLE TUBE STAND (GE)

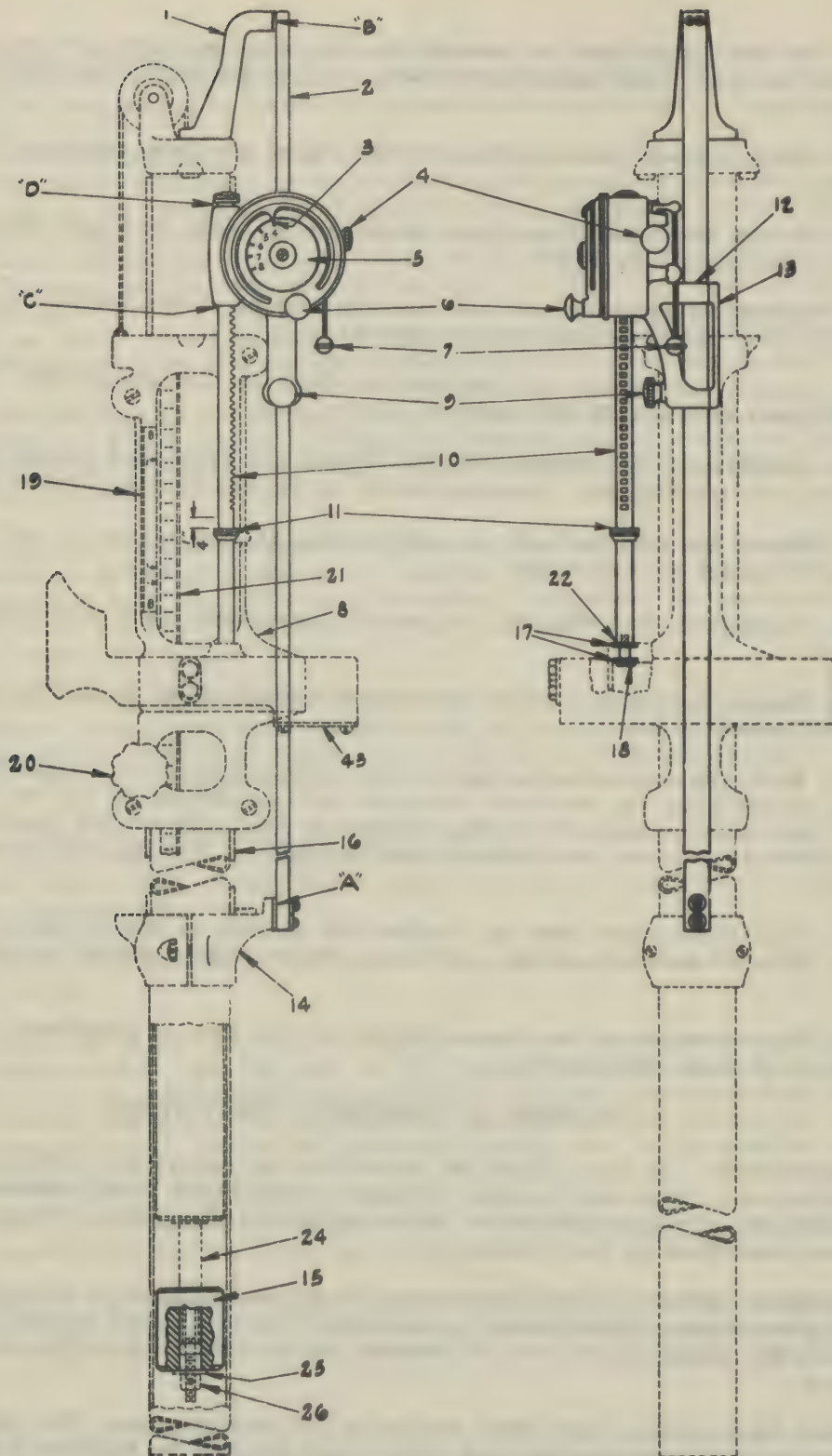


ILLUSTRATION 1

33 TABLE TUBE STAND (GE)

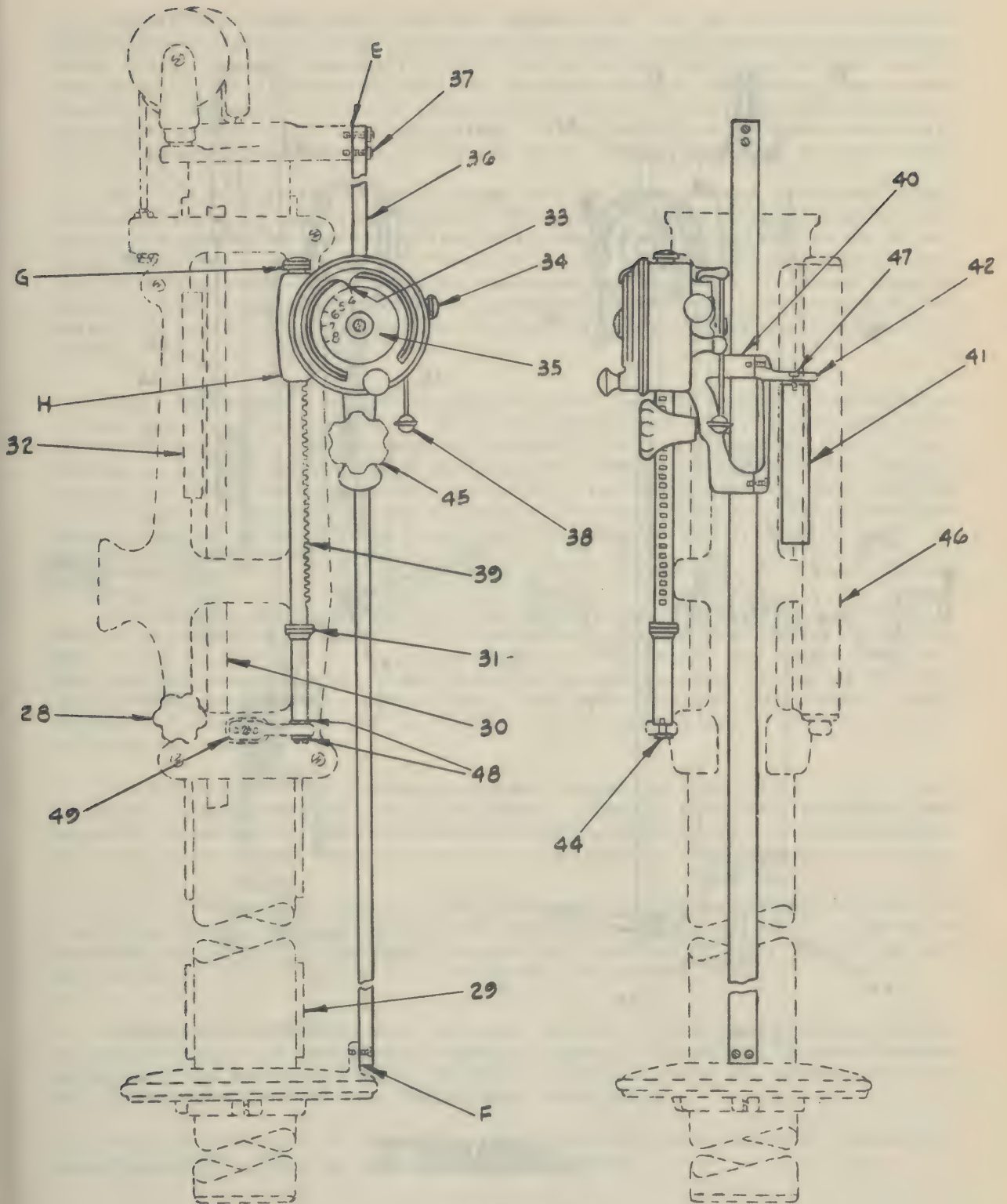


ILLUSTRATION 2

33 TABLE TUBE STAND (GE)

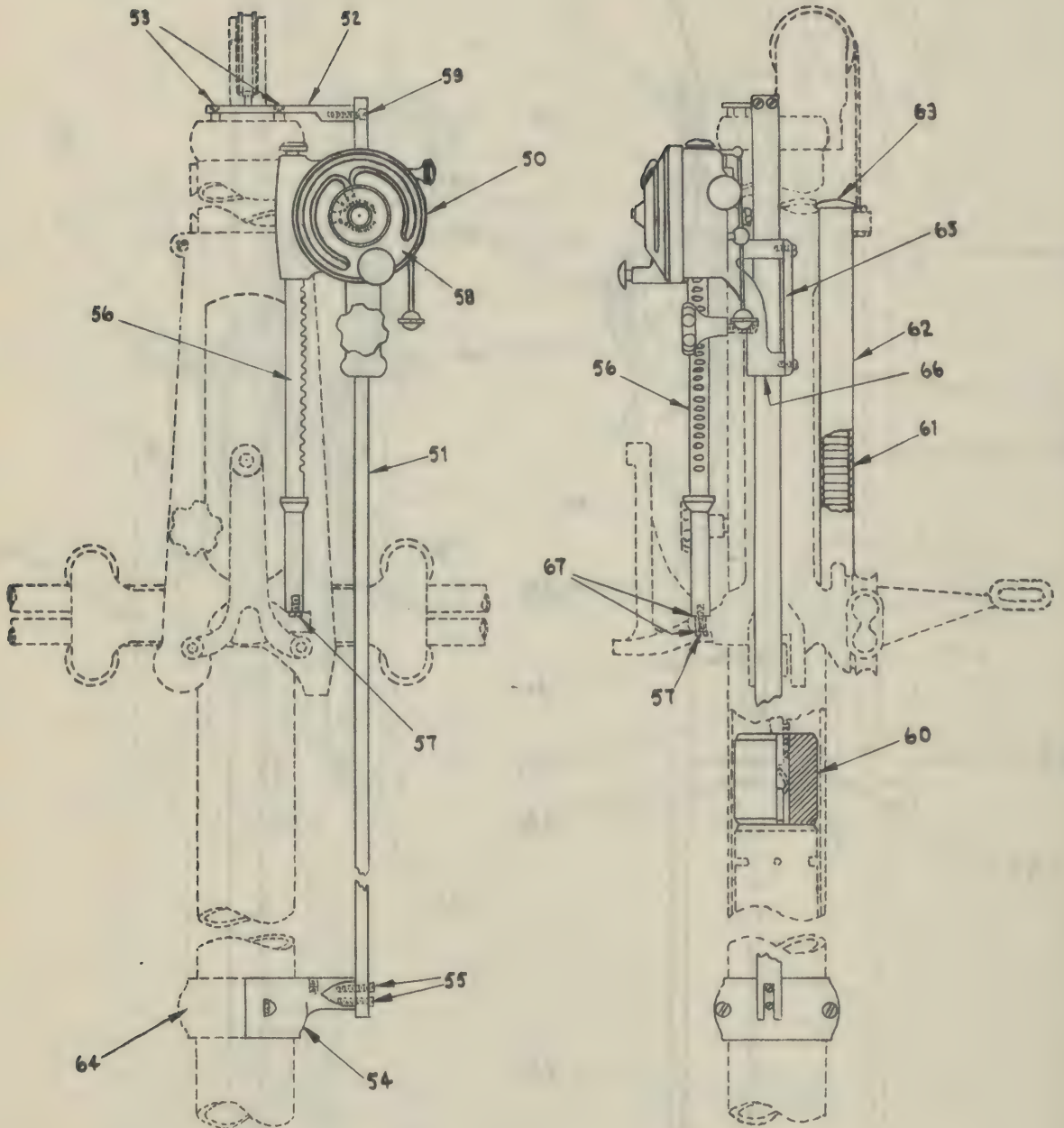


ILLUSTRATION #3

33 TABLE TUBE STAND (GE)

ELECTRICAL PROTECTION - Both the operator and the patient are fully protected against electrical shock. (This does not apply to the radiographic equipment which may be used in combination with the table, and which may or may not be shockproof.) The fluoroscopic tube and the high-voltage connections thereto are completely enclosed within the grounded metal table structure, preventing any accidental contact with the high-voltage. Even in the event a breakdown should occur, no electrical hazard is introduced as the current will pass to the ground.

The high-voltage current is brought into the table through shockproof high-voltage cables which may be connected to the overhead system above the reach of the operator or patient or connected directly to the transformer unit which may be adjacent to or away from the table. While it is never good practice to encourage anyone to place himself in contact with these cables, no danger will ensue from so doing, as they are fully protected by a grounded metallic sheathing completely enclosing the cables, thus eliminating the possibility of injury due to electrical shock.

X-RAY PROTECTION - As much protection to the operator against x-radiation as is practical has been provided. The x-ray tube proper is surrounded with x-ray protective material, and the metal structure of the table provides further protection to the operator against stray radiation. Direct primary radiation impinges against the heavy lead glass which covers the fluoroscopic screen, thus offering the operator a maximum of protection against the primary beam. The fluoroscopic shutter controls adjacent to the screen provide independent control of the width and height of the fluorescent area.

It must be remembered, however, that no devices or structures can be built which will eliminate the generation of secondary radiation from the patient's body when placed in the path of the direct radiation. To protect the operator against this secondary radiation, the usual protective precautions such as the use of lead-impregnated rubber aprons, gloves, etc., should be utilized. If desired, lead-impregnated shields which can be attached to the fluoroscopic screen and to the table can be supplied.

Nor can any practical design of equipment avoid the possibility of authorized or unauthorized persons carelessly or unwisely exposing themselves to direct radiation or to secondary radiation given off from the patient. Neither can the design of the equipment compel the operator or his assistant to take adequate precaution.

It is further urged that every one having anything to do with the work of the x-ray department be fully acquainted with the recommendations of the U. S. Bureau of Standards and of the International Roentgen Ray Committee on X-Ray Protection, and take adequate steps to insure their own protection against injury.

FLUOROSCOPIC SCREEN STAGING - Note that the entire fluoroscopic screen staging is mounted on the rear (opposite the operator) side of the table. There are no projecting parts on the front side of the table to interfere with the operator while he manipulates the screen during a fluoroscopic examination.

Three pivotal points on the screen frame supporting mechanism permit almost any desired angle or position of the screen to be obtained.

33 TABLE TUBE STAND (GE)

The fluoroscopic shutter controls are located adjacent to the screen where they are most convenient to the operator. The control arm itself is used in manipulating the screen. Moving the control arm moves the screen, and vice versa, but the shutter controls always remain in the same position relative to the screen.

When placing a patient on the table, and during radiography, the fluoroscopic screen may be positioned out of the way by lifting it up and pushing it back. It will automatically retain this position, leaving the table clear and unobstructed. If desired, the fluoroscopic screen may be removed entirely by loosening the screen lock and removing the screen.

The fluoroscopic carriage lock (on the back side of the table) provides a means of locking both the lengthwise and crosswise movements of the screen and tube.

POTTER BUCKY DIAPHRAGM - The Potter Bucky Diaphragm furnished with the Model 33 Table is of the latest improved type, incorporating the universal grid which greatly increases the latitude over which radiographs may be made without producing grid lines. The cassette tray incorporated in this diaphragm contains a device for automatically centering the cassette. To use, withdraw the slide as far as it will go, hold the two centering guides apart, place the cassette in position, push the two centering guides together until they touch the cassette on both sides, then push the small lever on the front edge of the cassette tray to the right, which automatically locks the cassette in position. To remove the cassette, reverse this procedure.

The grid is actuated by an efficient, spring-driven, oil-damped motor with a time control calibrated from 1/2 to 40 seconds for the standard grid and 1/10 to 40 seconds for the high speed grid. Since this is not a precision timing device, it should always be set for a time value slightly longer than the time of exposure desired.

The diaphragm is "cocked" by pulling out on the reset lever. After it is cocked, this lever will automatically return to its normal position when it is released.

The standard Potter Bucky Diaphragm is furnished with a manual pull-string release. After the grid is cocked it is set in motion by pulling this string. When so specified the standard diaphragm will be equipped with a "Bucky-timer" interlock which automatically synchronizes the making of the x-ray exposure with the grid movement. When this device is included, the grid is automatically started in motion by stepping on the foot switch of the x-ray timer. When so equipped the diaphragm is also provided with a switch, by means of which the interlock system can be cut out of the circuit. This switch is located near the timing dial and is in the correct position for use of the interlocking circuit when the plunger is pulled out. The "Bucky-timer" interlock is standard equipment with the high speed grid.

The Potter Bucky Diaphragm is counter-balanced for any position of the table, and may be locked in the desired position by turning the "Bucky" lock. It should always be locked when making more than one radiograph of a given part.

During fluoroscopy the diaphragm should be pushed to the opposite end of the table from which fluoroscopy is to be done.

COMPRESSION AND IMMOBILIZING DEVICE - The compression and immobilizing device supplied with the Model 33 x-ray table consists of a strong fabric belt which may be placed over the patient and anchored to the rear edge of the table. On the front edge of the table is a roller and ratchet mechanism which permits tightening the

33 TABLE TUBE STAND (GE)

band over the patient as desired. To release the compression band lift the ratchet lever toward the vertical position.

The compression and immobilizing device is adjustable over practically the entire length of the table, and may be removed completely by sliding it off the end of the rails on which it is mounted.

This device is useful in securing immobilization of the part to be radiographed and, when required, to apply compression. For compression purposes a rubber compression bladder in conjunction with the compression band will be found useful.

MOTOR-DRIVEN TILTING MECHANISM - The base unit on which the table structure proper is mounted contains the motor and motor controls for raising and lowering the table. Two foot-pedals projecting from the base of the unit, control the angle of tilt. The pedal on the right raises the table toward the vertical- the one on the left lowers it toward the horizontal or Trendelenberg position.

An angle scale on the gear sector indicates the exact angle of the table top in degrees above or below horizontal, from Trendelenberg to 45 degrees above horizontal.

The vertical and Trendelenberg positions are obtained through automatic stops. At these positions the depressed foot-pedal will raise and the motor will stop. The table cannot be forced beyond these positions.

HAND-OPERATED ELEVATING MECHANISM - The manually operated elevating mechanism serves the same function as the motor-driven mechanism, but in this case the motive power is obtained through turning the crank wheel by the operator himself.

The manually operated elevating mechanism is provided with an automatic brake which locks the table in the desired position the instant the crank wheel ceases to turn. The lock is automatically released when the operator begins to turn the crank wheel.

The crank wheel is designed to offer a minimum of obstruction to the operator while working alongside the table. For small angular adjustments the rim of the crank wheel may be grasped and turned to tilt the table.

For larger angular adjustments, the crank handle which folds into the crank wheel may be swung out where it will automatically lock in position. To fold the crank in the wheel, first pull straight out on it.

The angle scale on the base unit indicates the angle of tilt from horizontal- from the Trendelenberg position to 45 degrees above horizontal. The table stops automatically at the Trendelenberg and vertical positions.

COMBINATION HEAD AND FOOT-REST (Furnished with motor-driven table.) - The combination head and foot-rest furnished with the motor-driven table is adjustable in several positions over each end of the table. The studs on the bottom side of the handles fit into holes drilled in the side members of the table top. The plungers located within the handle-opening lock the head and foot-rest in the positions in which placed.

To install the head and foot-rest, lift up on both plungers. Place the studs into the holes in the side members of the table, release the plungers and pull the head and foot-rest toward the end of the table until the plungers snap into posi-

33 TABLE TUBE STAND (GE)

tion. Be sure both sides are secure before placing patient on the rest.

To remove the head and foot-rest, lift up on the plungers, move the head and foot-rest toward the center of the table, and lift off.

For use as a head or shoulder-rest, the center section may be removed by pushing in on the forked stud at the bottom edge of the rest and lifting the center section out. When the center section is replaced it will automatically lock in position.

FOOT REST (Furnished with the hand-operated table.) - This foot-rest is similar to the combination head and foot-rest furnished with the motor-driven table, but does not have a removable center section and its method of installation on the table top is somewhat different.

To install the foot rest grasp the two handles and push them together. Insert the studs in the holes in the side members of the table top and release the handles. The handles will swing out, locking the foot rest in position.

The combination head and foot-rest supplied with the motor-driven table can also be used on the hand-operated and, if desired, may be purchased at a nominal cost.

OPERATION - Most of the steps covering operation of the Model 33 Table have been covered in the description of the various integral parts. A few additional pointers are covered below.

USE OF THE FLUOROSCOPIC SCREEN - Manipulation of the fluoroscopic screen will be obvious on inspection. Two of the swivel movements may be locked by the screen lock and the screen-arm lock.

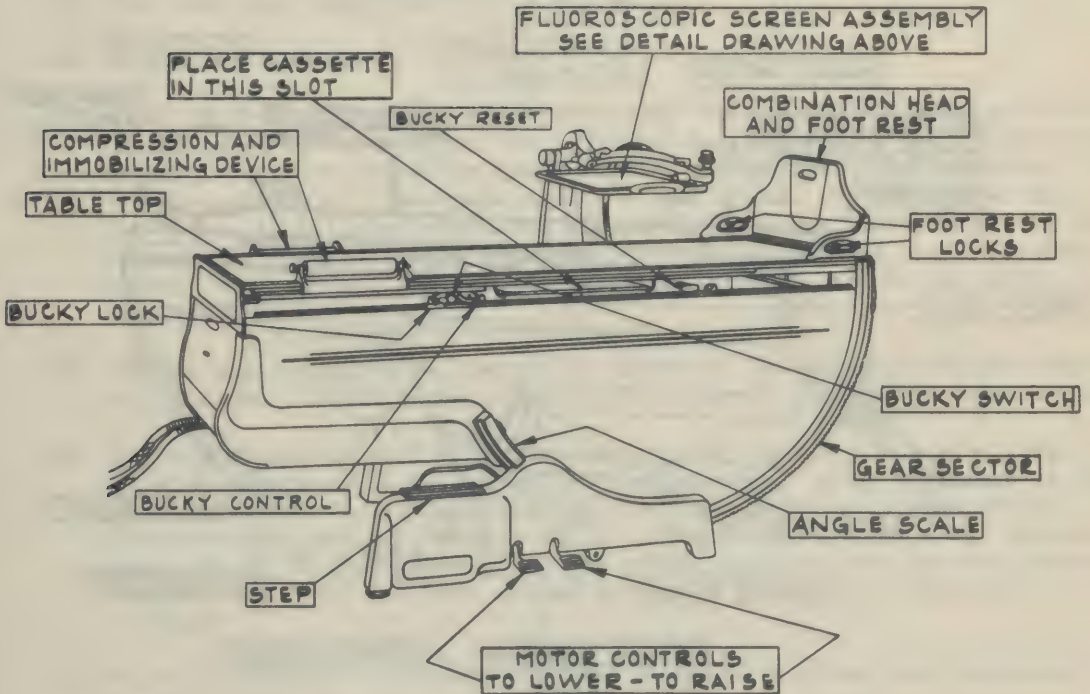
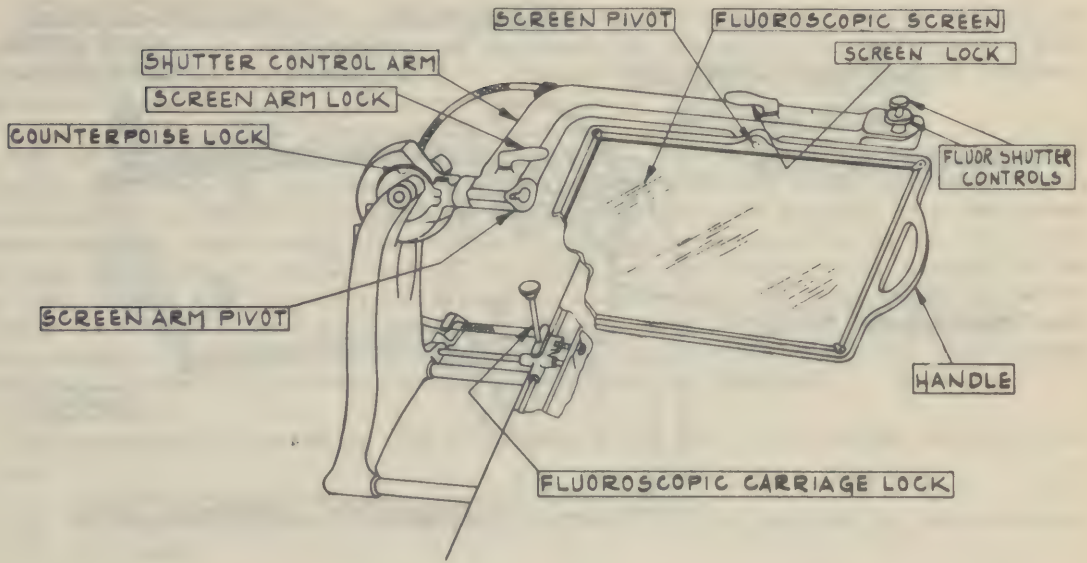
The two knobs on the shutter control arm provide independent control of length and width of the fluorescent area on the screen. These controls should always be regulated so that the fluorescent area is within the limits of the screen, thus protecting the operator against exposure to direct primary radiation.

For vertical fluoroscopy it will be desirable to disconnect the spring counter-balance and the screen arm. To do this, swing the screen away from the table as far as possible, pull out on the counterpoise lock, then push the screen in toward the table a short distance. To reconnect the spring counterpoise, swing the screen away from the table as far as it will go. The counterpoise lock will automatically snap into position, thus re-connecting the spring counterpoise.

OPERATION OF THE POTTER BUCKY DIAHRAGM - The Potter Bucky Diaphragm (unless it is equipped with a "Bucky-timer" interlocking switch) incorporates an audible signal which sounds shortly after the grid has started in motion, and again shortly before it stops. The x-ray exposure should be confined between these two signals, otherwise grid lines are likely to result from the fact that the grid becomes stationary.

The Potter Bucky Diaphragm is not a precision timing device and therefore should not ordinarily be used for timing x-ray exposures. It will generally be found desirable to set the diaphragm timing device slightly longer than the time of exposure, in order to make certain the exposure is confined to the time of grid travel.

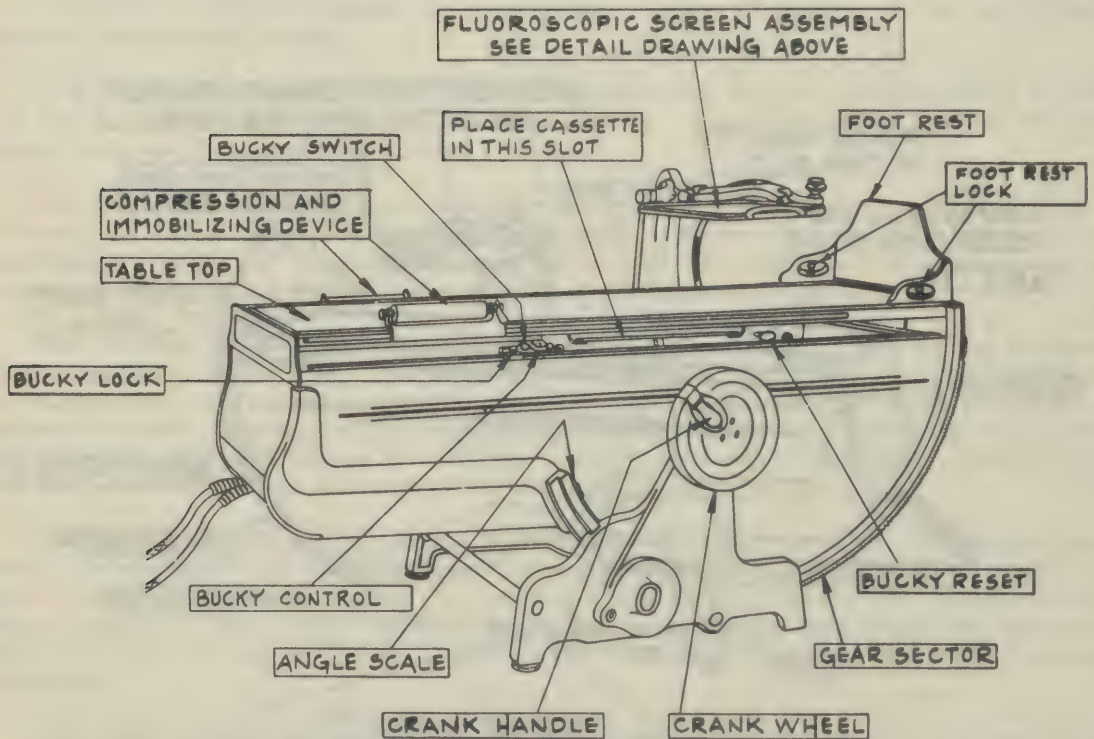
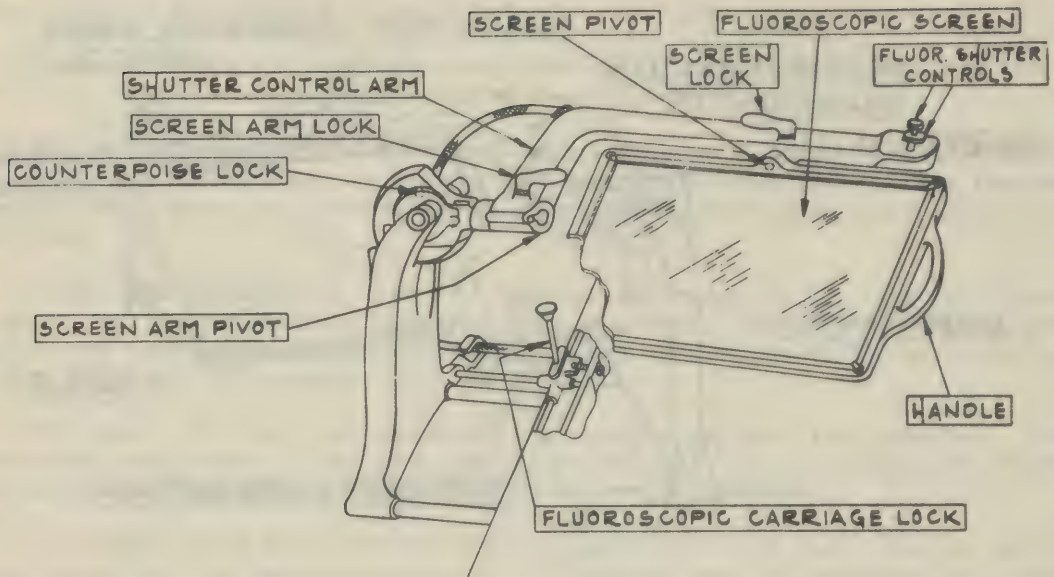
33 TABLE TUBE STAND (GE)



VIEW I

G.E. SERIES 33 MOTOR DRIVEN DIAGNOSTIC X-RAY TABLE

33 TABLE TUBE STAND (GE)



VIEW II

G.E. SERIES 33 HAND OPERATED DIAGNOSTIC X-RAY TABLE

33 TABLE TUBE STAND (GE)

The Universal grid with which this diaphragm is equipped permits the use of focal-film distances over a range of at least 20 inches to 36 inches, and also permits stereo shifts crosswise the grid without appreciably increasing the tendency toward grid lines.

USE OF THE BUCKY-TIMER INTERLOCKING SWITCH - This device is a means of automatically synchronizing grid movement with the making of the x-ray exposure. With this system, stepping on the foot switch starts the grid moving, but the x-ray exposure does not begin until after the grid is well in motion. The x-ray timer will terminate the exposure at the end of the time for which it is set, except in the event that should the time of grid travel be shorter than the time value for which the timer is set, the grid will terminate the exposure before it reaches the limit of its movement. It is of particular value for short time exposures where close coordination between grid travel and x-ray exposure is required.

The sequence of operating the diaphragm with the interlocking switch is as follows:

- (A) Place the cassette in position and see that the patient is properly positioned.
- (B) Set the time control to the desired time of grid travel. This should be just slightly longer than the time for which the x-ray timer is to be set.
- (C) Set the x-ray timer to the desired exposure time.
- (D) See that the "Bucky" switch is pulled out.
- (E) Cock the diaphragm.
- (F) Step on the foot switch. This energizes the magnetic release and starts the grid in motion. After the grid has started moving the interlocking switch starts the timer in operation and begins the x-ray exposure. The x-ray exposure will continue until the end of time for which the timer is set, when it will be terminated except in the event that should the grid travel faster than the time for which the timer is set the interlocking switch will automatically terminate the exposure before the grid stops moving.
- (G) If for any reason it is desired to terminate the exposure before the end of the time for which the timer is set, simply release the foot switch.
- (H) For non-diaphragm work or for any work where automatic synchronization of grid movement and x-ray exposure is not desired, turn the inter-locking control switch on the diaphragm to the "off" position, (push it in). In this position the foot switch may be used to turn on the x-ray exposure, regardless of the position of the grid, and the grid may be released independently of the foot switch action by pulling on the pull string release.
- (I) With the "Bucky" switch in the "on" position (pulled out), an x-ray exposure cannot be made except while the grid is moving.

FLUOROGRAPHIC SCREEN UNIT - This unit is a combination fluoroscopic and radiographic device which permits the fluoroscopic visualization of the part desired

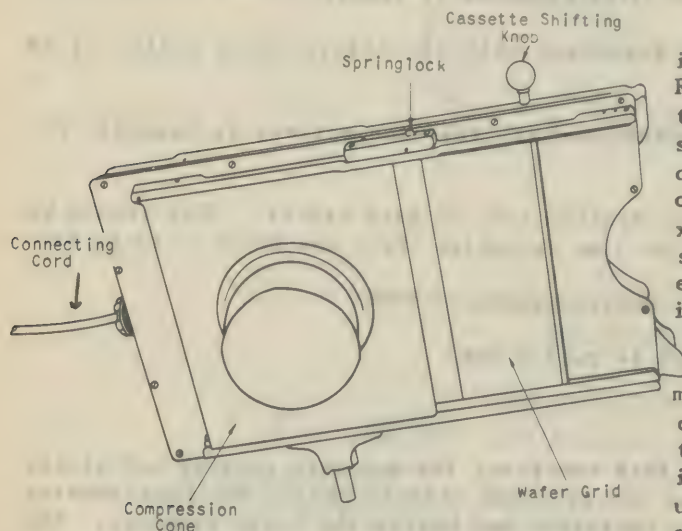
33 TABLE TUBE STAND (GE)

to be recorded on the film, quickly followed by a radiographic exposure of proper exposure factors without resetting the control of the x-ray unit.

The fluorographic screen unit mounted in place of the regular fluoroscopic screen and the dual control unit arranged for mounting inside the generator control stand are required to complete the fluorographic unit.

The fluorographic screen unit and the regular fluoroscopic screen are interchangeable. Since their weights are approximately the same, no complications from the standpoint of counterbalancing is present.

The fluoroscopic screen is the type B Patterson screen mounted across the fluoroscopic aperture 7 by 9 inches in size.



FLUOROGRAPHIC SCREEN UNIT, BACK VIEW

The cassette tunnel provides for insertion of one 6-1/2 by 8-1/2 inch Rayspeed cassette or equivalent. For those who desire to use smaller cassettes, an adapter frame for 5 by 7 cassette is available. The loaded cassette is fully protected against x-radiation of fluoroscopic intensities. The cassette guides permit easy insertion of the cassette even in the darkened room.

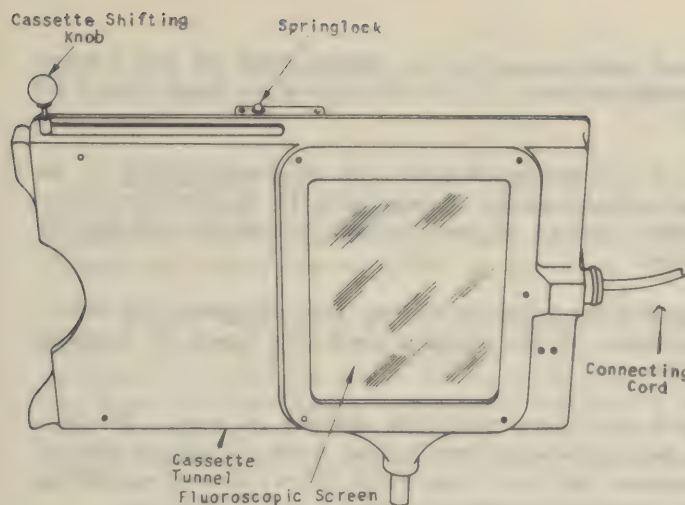
The wafer grid is permanently mounted into the assembly and can be quickly moved along the tracks under the fluoroscopic screen when its use is desired, and out of the way if its use is deemed unnecessary. Retention of the grid in the latter position is accomplished by a spring incorporated in the track channel. In many instances the use of a wafer grid for the elimination of the secondary ra-

diation will result in material improvement of visible detail, both in fluoroscopy and radiography.

The cassette shifting knob serves to shift manually the cassette into the radiographic position and to return the cassette back into the protected tunnel. This knob also serves as a spring lock for allowing the cassette to be inserted into the tunnel, and for preventing the cassette from falling out in the event that the fluorographic screen unit is tilted when the table is in the horizontal position.

In addition, this knob fulfills another important function, namely, acting upon the lever built into the fluoroscopic screen unit. This lever in turn actuates the contacts electrically connected with the dual unit. Shifting the cassette below the fluoroscopic screen for radiographic position closes the contacts which causes the generator setting to be changed from fluoroscopic to radiographic output. Shifting the cassette back into the protective enclosure opens the contacts which automatically reduces the generator output to fluoroscopic intensity. Connecting cord is plugged into the fluorographic screen unit in order to effect electrical connection between the contacts contained therein and the dual unit in the control stand.

33 TABLE TUBE STAND (GE)



FLUOROGRAPHIC SCREEN UNIT

Compression cone provides a highly satisfactory means of applying compression. Two cones are included: one is 4-1/2 in. and the other 3-1/2 in. in diameter, each mounted on a plate. The cone plate is inserted from the operator's side of the unit into the outer tracks. The cone may be left in its first position away from the screen and then readily shifted to its second position in front of the screen when its use is desired. As the cone is moved to the latter position, the spring locks it in place.

Both the amount and the direction of pressure can be controlled conveniently and the desired position may be positively retained through the use of the locking devices with which the table is equipped.

INSTALLATION OF THE FLUOROGRAPHIC SCREEN UNIT - Incorporated as part of the table are several devices which are briefly mentioned here because of their relation to the fluorographic screen unit.

Screen lock and screen arm lock are employed to retain the fluoroscopic screen in the desired position with respect to its rotation about both axis. A quarter of a turn will lock and release the rotation.

Fluoroscopic shutter controls provide means of independent control of both width and length of the illuminated area on the screen. In addition, this control will be found convenient to do much of the screen manipulation.

Compression ratchet assembled on the screen staging upright permits compression to be retained as applied. The control lever has two positions; in one position the ratchet is engaged and in the other it is disengaged.

The fluoroscopic screen may be removed conveniently while the table is in either the horizontal or vertical position, the horizontal position being more preferable.

Before withdrawal of the regular fluoroscopic screen is attempted for the purpose of interchanging it with the fluorographic screen unit, certain precautions must be followed to prevent possible injury to any one near the table and to the table itself.

Before removing the screen, make sure that the ratchet mechanism on the screen staging upright is disengaged. Swing the screen away from the table as far as it will go, pull out the plunger lock in the screen arm swivel assembly, then bring the screen down toward the table as far as it will go and release the plunger. This procedure disconnects the counterbalancing spring, and permits removal of the screen without the screen arm flying up with the possibility of attendant injury to anyone in its path. If this method is followed in removing the screen this possibility will be eliminated.

33 TABLE TUBE STAND (GE)

MAINTENANCE - All X-Ray equipment and apparatus is constructed of the finest materials and highest workmanship obtainable. It is designed to give years of service with a minimum of attention.

Any mechanical device, however, be it an automobile, an electric motor or an x-ray table, requires a certain amount of attention to maintain it at maximum efficiency. There is nothing in the ordinary course of maintenance but which can easily be cared for by the doctor or technician.

Cleanliness is the first rule to follow in maintaining any equipment at maximum efficiency. Keep your apparatus clean. A few minutes each day spent in keeping your apparatus clean is a wise investment.

The amount of attention required will vary with the amount of use. The directions following are prepared to meet average conditions such as daily use of three to four hours. Increase or decrease in this time will effect a corresponding change in the frequency at which maintenance should be given.

OILING OR GREASING - HAND-OPERATED TABLE - The liberal use of ball bearings and the design of all other bearings where efficient lubrication or free action is required, eliminates the necessity of any special attention to lubrication.

OILING OR GREASING - MOTOR-DRIVEN TABLE - As with the hand operated table, the liberal use of ball bearings and the design of all other bearings where efficient lubrication or free action is required, eliminates the necessity of any special attention to lubrication with the exception of the motor. Once a month a few drops of medium machine oil should be applied to the oil cups located on either end of the motor.

OPENING TABLE FOR CLEANING OR INSPECTION OF INTERIOR - The Model 33 Table may be opened for cleaning, inspection, or adjustment of the interior as follows:

(a) Elevate the table to the vertical position.

(B) Remove the 6 screws holding the upper panel on the under side of the table in place, and remove this panel. This will permit access to any of the interior parts.

CLEANING THE INTERIOR OF THE TABLE - All parts of the table, both inside and out, should be kept clean, but it is particularly important that all parts pertaining to the high-voltage circuit be kept clean. Parts in the high-voltage circuit have a tendency to collect dust more rapidly than other parts, hence will require more frequent cleaning than the rest of the table.

Once a month all parts of the high-voltage circuit on the interior of the table should be carefully wiped clean. The high-voltage parts include the tube, cord reels, bushings on which the cord reels are mounted, and the two shockproof high-voltage cables at least as far back as the clamps which support them. Use only clean, dry rags. Do not use soap and water, nor any cleaning agents. The use of soap and water alone, and some cleaning agents, may cause failure of the insulation. A clean, dry rag is sufficient.

During the monthly cleaning of the interior, all tracks on which rollers move (this includes the Potter Bucky Diaphragm and the lengthwise and crosswise movements of the fluoroscopic screen staging) should be wiped to remove any foreign material

33 TABLE TUBE STAND (GE)

that may have accumulated. If these tracks are wiped with a rag slightly moistened in oil, sufficient lubrication will be provided to insure smooth operation of the various parts.

REPLACEMENT OF THE TUBE - The manner in which the tube is held in position will be obvious on inspection. When it becomes necessary to change a tube, first disconnect the leads to the anode and cathode ends, then remove the tube from its clamps and place the new tube in position in a similar manner.

REPLACEMENT OF FUSES - MOTOR-DRIVEN TABLE - The motor used with the motor-driven table is protected against overload by means of two fuses located in the base of the unit. If the motor fails to operate, first make sure that power service has not been disconnected at some point before it reaches the table. If it is suspected that the fuses may be burned out, remove the two thumbscrews and lift off the panel of the base unit. Use only 15 ampere fuses for replacement.

REMARKS - Before it left the factory, this Table was carefully tested and adjusted by men who have had years of experience in matters of this kind. No adjustment or service of any kind other than stated in preceding paragraphs should be attempted, unless something unforeseen develops which definitely indicates the need for this service.

DIRECTIONS FOR INSTALLING GENERAL ELECTRIC MODEL 40 TUBE STAND AND UNIVERSAL SIDE RAIL UNIT FOR KX-11 X-RAY UNIT

1. **THE UNIVERSAL TYPE SIDE RAILS AND THEIR ATTACHMENTS** - The Universal Side Rail Unit will appear as shown in Illustration 1, Page 46, when properly assembled.

2. The lower rail Fig. 143, is distinguished from the upper rail by its dark finish. These rails are heavy and two men should be used to assemble them. Place both rails and the small locking rail Fig. 144, on a strong box or other suitable support, and then fasten the left end support Fig. 145, in place. This is the one without the bumper extension Fig. 168. **NOTE:** When fastening the lower rail to the end support, see that it is in the proper position so that the holes for fastening the spacers for the table will align correctly. (See table directions.)

3. Slide the lower and upper rail attachments Fig. 146, and 147, respectively, onto their corresponding rails. The locking shoe shall be slipped over the locking rail when sliding the upper rail attachment into position. Insert the locking handle Fig. 149, into the threaded portion of the locking shoe. Over this locking shoe position the fitting for the horizontal stereoscopic shift attachment.

4. The other end support Fig. 151, shall now be bolted against the open end of the rails. This end support may be identified by its longer bumper stud Fig. 168. It must be placed on the end shown in order to prevent the lock retaining end Fig. 147, of the upper rail attachment from bumping against this end support. Do not fasten the bolts in the end supports completely, until the rail assembly has been lifted off the supporting box and placed in its upright position on the floor. The rails are now ready to receive the tube stand.

5. **ADJUSTMENT AND LEVELING OF SIDE RAILS** - To give the side rail unit a firm footing on uneven floors, two leveling pads Fig. 161, have been provided. Turn the slotted stud of these pads protruding thru the front feet of the rail support until the proper footing has been obtained.

33 TABLE TUBE STAND (GE)

6. The upper and lower rail attachments Fig. 147 and Fig. 146, have eccentrically mounted ball bearing rollers to take up play on the rails. To adjust the rollers, loosen the two hexagonal bolts Fig. 162, and turn the two knurled discs which are located immediately over the heads of these bolts, until the rollers fit snugly against the rail. Do not adjust these rollers too tight as a slight clearance of about $1/64$ " should exist between the rollers and the rail. It is best to move the tube stand over the entire range of the side rails when making this adjustment, and then after the adjustment has been found to be satisfactory to tighten the hexagonal bolts firmly. *NOTE:* The Universal Side Rails if used with a Model 33 Table, must be grounded. To do this, connect a lug fastened to a #8 RC wire to either chromium plated hexagon screw holding the rail to the end supports. Connect the other end of this wire to a permanent ground such as a cold water pipe. Do not connect to a gas pipe. Do not use conduit as a ground connection.

7. The lower rail attachment is equipped with a similar adjustment except that there is only one adjustable roller which is located in the back of the rails. Adjustment of this roller shall be made in exactly the same manner as specified in the previous paragraph.

8. The two guide rollers Fig. 163, shall be adjusted by slightly loosening the screw Fig. 164, in back of the hexagonal stud Fig. 165, and then turning the hexagonal studs until the rollers hug the rail. Enough clearance between the rollers and the rail must be provided so that the stand will roll easily and smoothly along the entire length of the rails.

9. With the aid of a plumb bob or spirit level, placed against the column of the tube stand, the perpendicular adjustment of the tube stand shall be determined. If the tube stand need be tilted backward or forward, raise or lower the two leveling pads Fig. 161, until the desired position has been obtained.

10. SPACING THE RAILS IN RELATION TO X-RAY TABLES - The side rails when placed alongside the x-ray table shall be spaced from the tables by means of the two spacing brackets Fig. 166. The markings on the tube carriage must then be checked so that they correspond with the center of the x-ray table as explained under paragraph headed "Crosswise Centering of Tube Carriage". Where it is desired to bolt the side rail unit to the floor, it may be done by inserting bolts through the rear feet of the end supports Fig. 145 and 151.

11. ASSEMBLY OF MODEL #40 TUBE STAND FOR DX CASING - The Model #40 Tube Stand will be shipped dismantled into several assemblies; namely, column with pulley cap, counterweight and cable attached, vertical carriage and horizontal tube carriage with parts to mount the x-ray tube.

12. ASSEMBLY - Unpack all units and place them on pieces of soft paper or padding material to prevent marring the finished surfaces. The tube column shall be kept in a horizontal position when removing it from the box, so that the counterweight will not slide out of the lower end and cause damage to the floor or the other equipment. *NOTE:* The counterweight has been anchored for shipment by means of a steel plate across the bottom of the column. This plate must be removed and discarded. To remove the plate, loosen the set screw in the nut Fig. 69, and remove the nut.

13. Unwrap the tube stand column and remove the pulley cap assembly by taking out the two screws Fig. 51, Illustration 1.

14. Slide the vertical carriage Fig. 52, over the column, starting at the

33 TABLE TUBE STAND (GE)

top end. Care must be used not to injure the finish of the column. Also make sure that the indicating scale Fig. 53, is in proper relation to the smaller indicator, Fig. 54. Replace the pulley cap Fig. 55, and insert the threaded stud Fig. 56, thru the lug on the carriage and install the nut Fig. 57. Draw this hexagon nut up tightly in place.

15. The tube stand is now ready to be placed into its base socket on the side rail unit. When raising the column to a vertical position, care must be used to perform this operation slowly so that the counterweight will slide slowly towards the bottom of the column.

16. Inspect the cable to see that it is not twisted. Also make sure that the cable is taut at all times when raising the column into position.

17. The horizontal carriage Fig. 1, shall be assembled next.

18. This is assembled to the vertical carriage in the manner shown in Illustration 3. Loosen the screws in the nut Fig. 60, and remove this nut and the washers from the stud on the vertical carriage.

19. Slide the horizontal carriage over this stud. The large fibre friction washer Fig. 59, must be placed over the stud as shown. Replace the four smaller washers in the following order, first the fibre, then the steel and finally the friction washers with their convex surfaces to the outside. Replace the nut Fig. 60, and tighten to obtain the desired friction, then lock the set screws in this nut firmly in place.

20. ATTACHMENT AND MOUNTING - The height of the tube column shall be adjusted so that the distance between the floor and the bottom end of the tube column is 5-1/4". A measuring scale Fig. 61, is provided on the end of the horizontal carriage for measuring the exact distance from the target of the x-ray tube to the patient.

21. HEIGHT ADJUSTMENT OF TUBE COLUMN - As explained in the preceding paragraph, the height of the tube column shall be adjusted so that the distance from the floor to the bottom of the column is 5-1/4". This adjustment is made by raising or lowering the column in its supports, securely locking it in place after the adjustment has been made. The graduated nameplate on the column should then indicate the correct distance between the table top and the target of the x-ray tube. To check this, position the arrow marked "Table Top" on the small scale, at 25" on the long nameplate on the column and lock the tube carriage at this point. The distance from the center of the target (white dot or casing) to the table top, should measure 25". Readjust the height of the column if the setting should be found in error. For some tables, it may be necessary to drill a new set of holes for the long nameplate on the column. Use a #41 drill and a 4-36 tap for threading the holes.

22. MOUNTING THE DX CASING - Instructions for mounting the DX casing to G.E. tube stands will be found in the directions accompanying the tube unit.

23. Mounting of the DX casing on the Model 40 tube stand is the same as that for the Model #22 tube stand. No counterweight adjustment is necessary on the Model #40 stand when used with the DX tube unit.

24. CROSSWISE CENTERING OF TUBE CARRIAGE OVER TABLE TOP - To adjust the tube carriage so that the x-ray tube target will be in line with the center line of the table, the following procedure will be necessary.

33 TABLE TUBE STAND (GE)

25. Position the tube carriage over the center of the table both lengthwise and crosswise. Lock the tube carriage in place in the center of the rod Fig. 64. With the aid of a plumb bob, check to see whether the center of the x-ray tube target is in line with the center of the table. If it is, the rod is positioned correctly and no adjustment need be made.

26. If after making the adjustments as described above, the target of the x-ray tube does not align with the center of the table, then the rod Fig. 32, shall be removed and repositioned, using another set of the three sets of holes. If none of these three sets of holes will give the desired adjustment then the Universal Side Rails, if they are being used, may be positioned a little closer or farther away from the x-ray table.

27. In moving the side rail closer to the table, be certain that the fluoroscopic screen carriage of the x-ray table will pass the tube stand column without touching it.

28. Slide the tube stand along the side rail and note if the relation between the plumb bob and the center line of the table changes. If necessary shim between the side rail unit and the table with fibre washers until the side rail unit parallels the table.

29. With the plumb bob positioned over the center line of the table spot drill the stereo locking rail Fig. 64, at the point indicated by Fig. 62. This point is where the white line Fig. 63, on the stereo-shifter lock meets the locking rail. Use a #33 drill for spotting and fill the spot with red or black lacquer.

30. This completes the assembly of the Model #40 Tube Stand.

31. Information for mounting the tube unit will be found in the directions which accompany that piece of equipment.

32. FASTENING THE SHOCKPROOF CABLE SUPPORT TO THE UNIVERSAL SIDE RAIL UNIT - If a Universal Side Rail Unit is already a part of the installation, it will be necessary to provide the four holes in the upper rail for supporting the two castings Fig. 102. These holes shall be drilled with a #20 drill and tapped for a 10-32 machine screws.

33. Location of these holes can be easily determined by assembling the bracket Fig. 102, to the cable channel and then marking the rail for the mounting holes by holding the assembly in position.

34. On side rail units ordered with the cable supports, these holes are provided.

35. ASSEMBLY - Fasten the two supporting brackets Fig. 102, on the upper rail of the side rail unit, using the machine screws provided.

36. Next fasten the castings Fig. 110 and Fig. 108 to the cable channel Fig. 109, using the 1/4"-8-32 round head machine screws furnished. These screws shall be inserted thru the brackets from the table side of the side rail unit.

37. PLACING THE SHOCKPROOF CABLES - Remove the lower portion of the castings Fig. 103 and Fig. 105.

38. Place the shockproof high-voltage cables one on top of the other, inside

33 TABLE TUBE STAND (GE)

the channel. Install the clamp Fig. 103, at the transformer end, and draw it up snugly against the cables. Do not tighten too tightly and allow sufficient slack in the cables to avoid any sharp bends at the high-voltage transformer.

39. Next bring the cables around inside the channel. Place the clips Fig. 106, around the lower cable, and snap them in place inside the channel Fig. 109. Space the clips at intervals frequent enough to prevent the cables from sagging.

40. Install the lower portion of the casting Fig. 103. When doing this, insert the small aluminum spacer Fig. 104, between the two cables. Tighten the clamp securely. Details for connecting the shockproof cables to the energizing equipment will be found in the directions accompanying that unit.

41. POSITIONING SHOCKPROOF CABLES WHEN THE HIGH-VOLTAGE TRANSFORMER IS PLACED BEHIND THE SIDE RAILS - As shown in illustration 1A, the positioning and supporting of the shockproof cables is self-explanatory. The casting Fig. 169, is supported at the end of the side rail unit by means of the two bolts Fig. 170. These bolts are a part of the Universal Side Rail Unit.

42. The other supporting casting Fig. 171, is fastened to the upper rail by means of two screws (furnished). The cable guards Fig. 172, are placed in the end of the bracket Fig. 171. Note that the threaded part of the fitting on the cable is not used. Clamp the smooth surface of the fitting in the clamp.

43. The high-voltage transformer shall be positioned as shown in the plan view of Illustration 1A, to insure proper cable lengths.

33 TABLE TUBE STAND (GE)

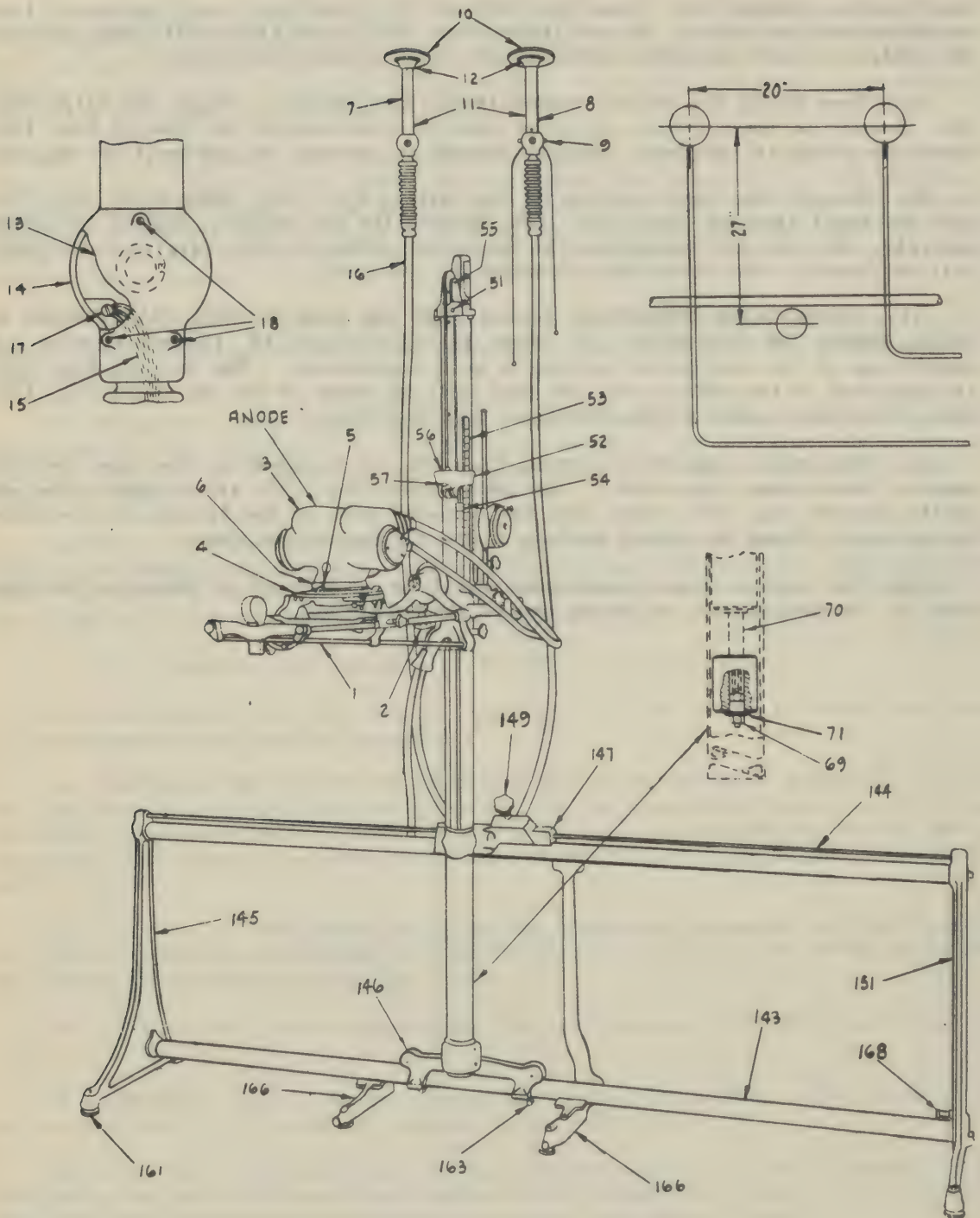


ILLUSTRATION I

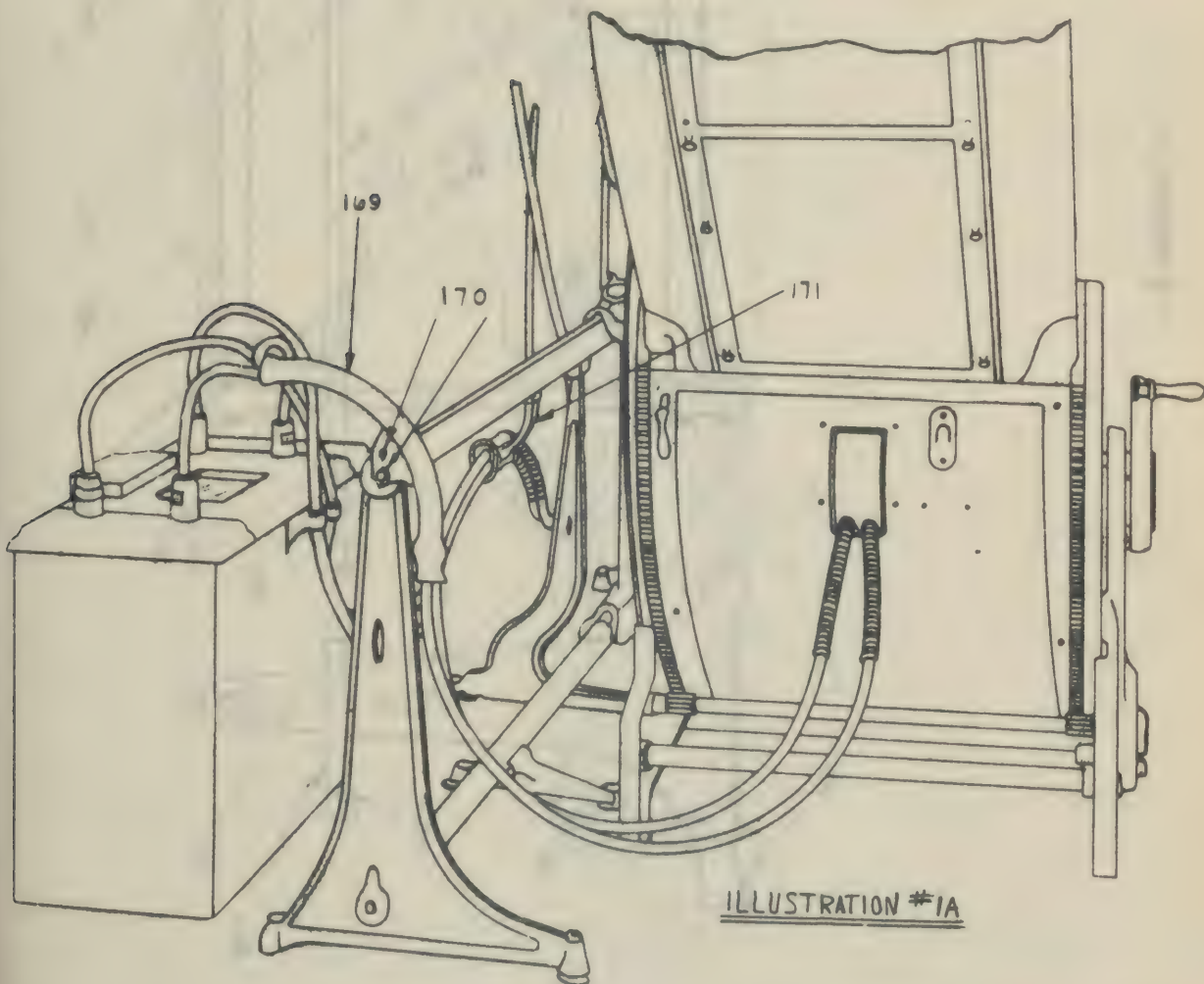
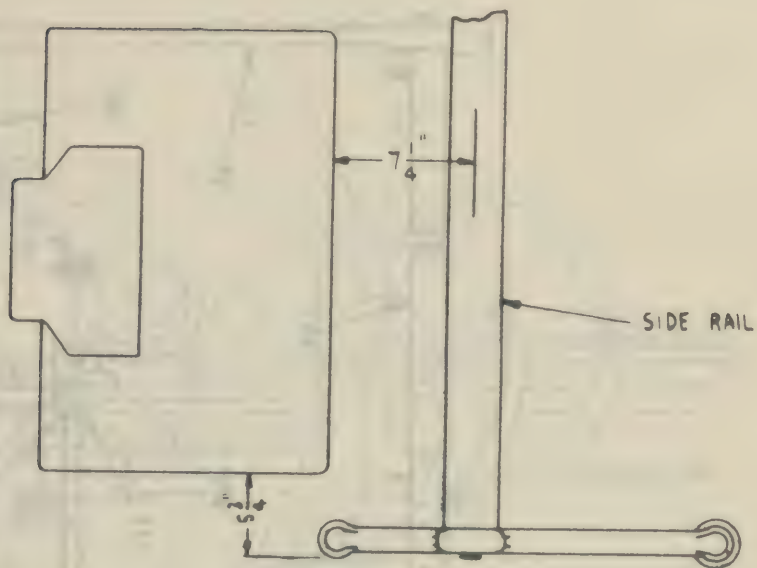
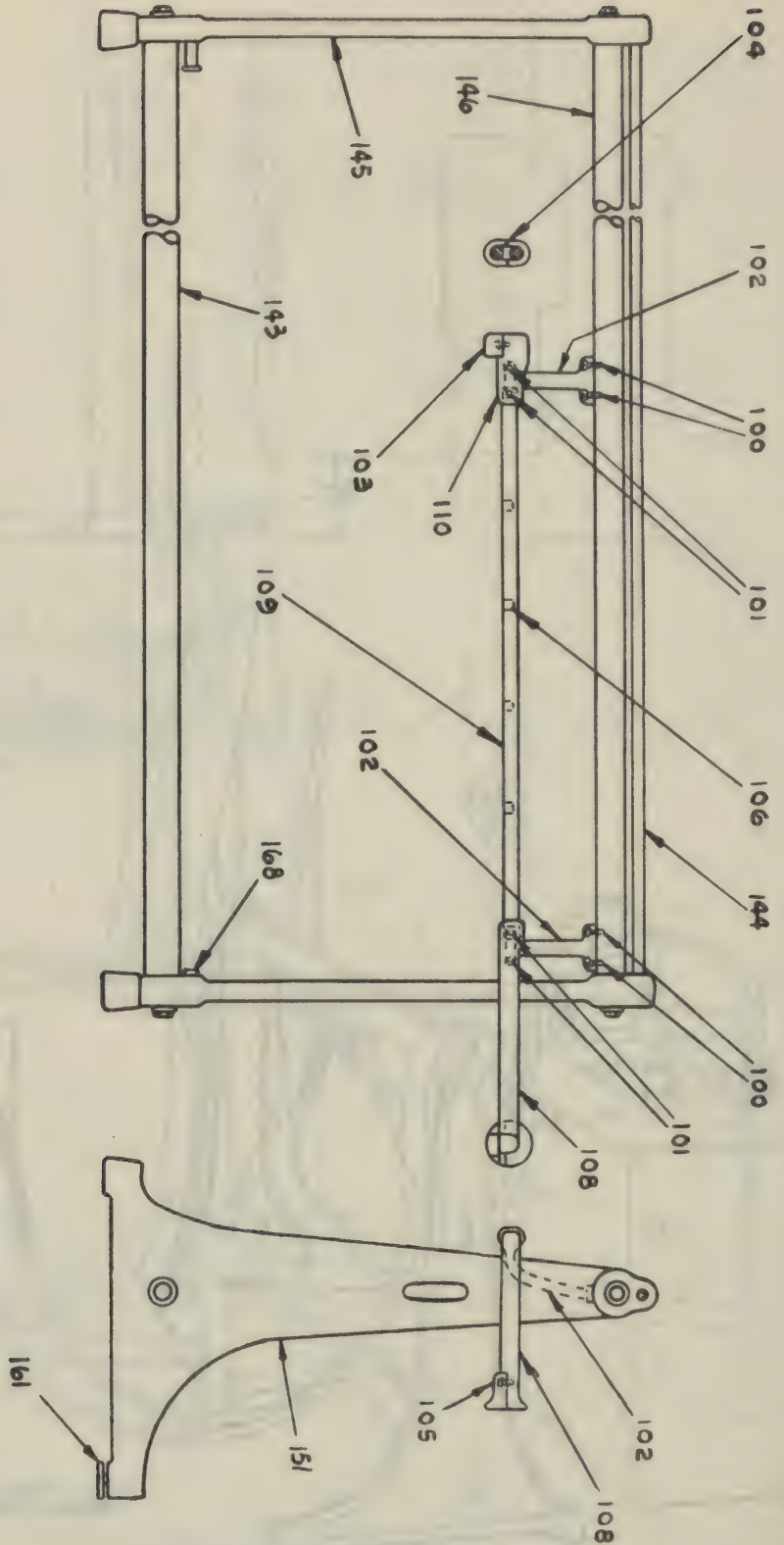


ILLUSTRATION #1A



VIEW 2

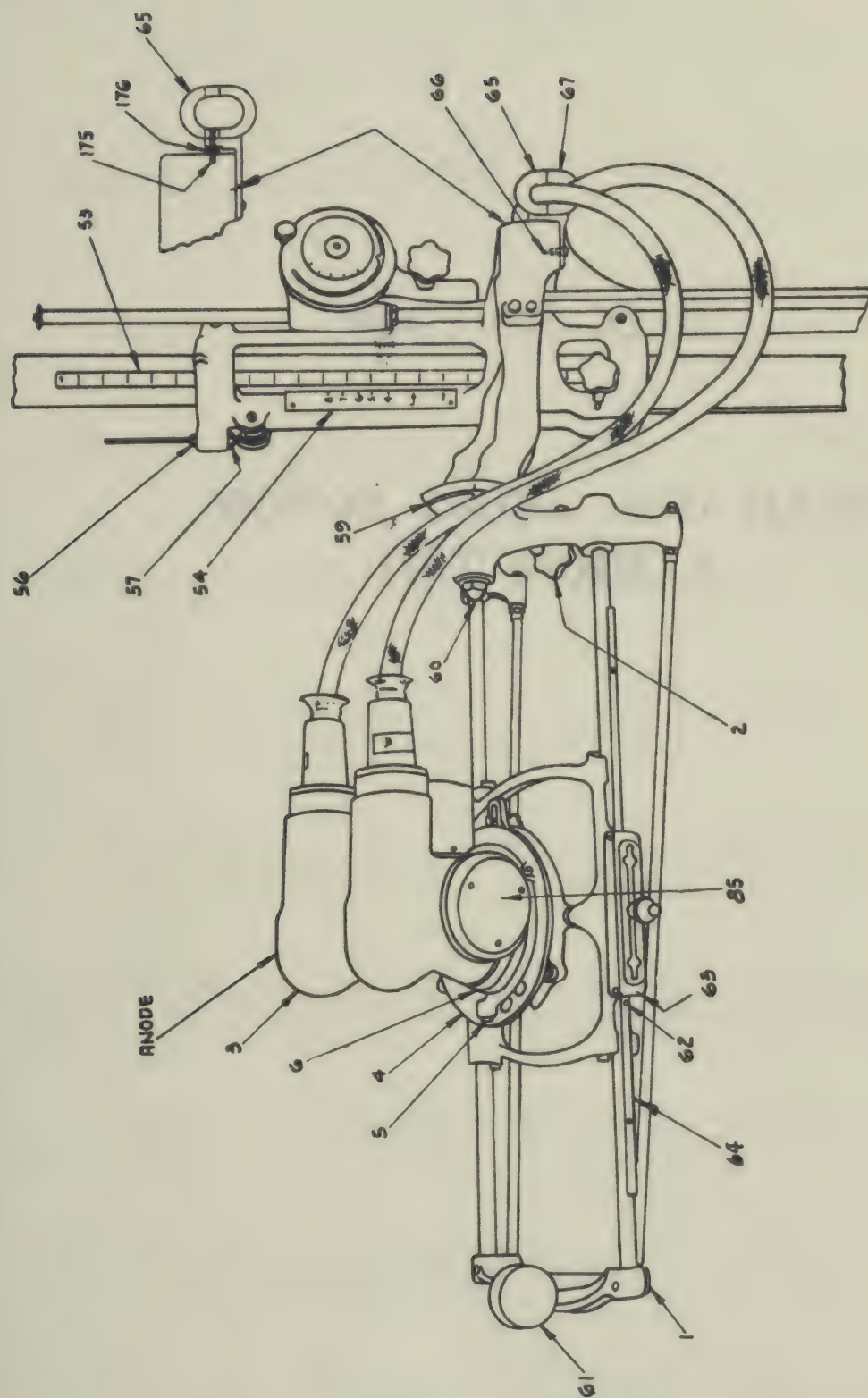


ILLUSTRATION 3

SECTION XLIX

MOTOR DRIVE AND HAND TILT MODELS

SECTION XIX

TILT ROTOR DRIVE AND HAND
TILT ROTORS

MOTOR DRIVE AND HAND TILT MODELS

INSTRUCTIONS FOR THE INSTALLATION AND OPERATION OF THE WAITE "CENTURY"

1. INSTRUCTIONS FOR ASSEMBLY - After the units have been unpacked, a careful check should be made with the packing slip and the units, to be absolutely certain that no parts have been left in any of the packing cases.

2. If shortages occur they must be reported immediately. If the equipment shows any signs of external injury, the crates should be examined and the incident should be reported to the carrier, filing claim for the damage done.

3. This unit is available in several models, some of which are indicated in the illustrations. Most of this instruction applies in general to all models. Other sections are devoted to specific types. It is advisable to read carefully the general section and then locate the section applicable to the model at hand.

4. TABLE--*Positioning* - Move the table to approximate position. *Warning--If it is necessary to tilt the table from the horizontal, it must be remembered that the table is considerably out of balance until the counterweight is installed. The head end will be heavy. Care must be exercised to prevent the head end from falling when the lock is released.*

5. TABLE--*Moving through narrow doors* - If the doorway is less than 33", it will be necessary to remove the base assembly from the table body.

6. Remove the table top. Remove the machine screw from the Bucky chain at the bracket on the Bucky. Keep the screw in the chain to mark the point of attachment when replacing the Bucky. Now support each end of the table on boxes, being sure to protect the finish with rags against abrasion. Remove the counterweight locking screw #10 Fig. 5 and move the horizontal carriage to the foot end. This must be done in order that the counterweight clear the rear pivot. Tie the carriage securely to the foot end of the table. Extreme care must be observed in removing the clutch assembly. Proceed as follows:

Remove the snap ring found at the extreme end of the clutch assembly and the pin through the shaft. Remove the clutch face; remove the 10-32 screw and retaining clip found at the side of the driving mechanism #56 Fig. 5. Carefully remove the driving gear and the toothed ratchet found beneath the driving gear. Do not make any attempt to remove the drive shaft for the Bucky from the pivot #58 Fig. 1, but push it in until it is flush with the outside of the pivot #58 Fig. 1, at the bottom of the slot. The above must be done, otherwise the friction springs on the inside of the drive shaft are apt to be lost. Now with a heavy screw driver, remove the pivot #58 Fig. 1 from the Bucky driving mechanism housing, and with a piece of wood or other soft material drive the rear and front pivot shafts clear of the table body.

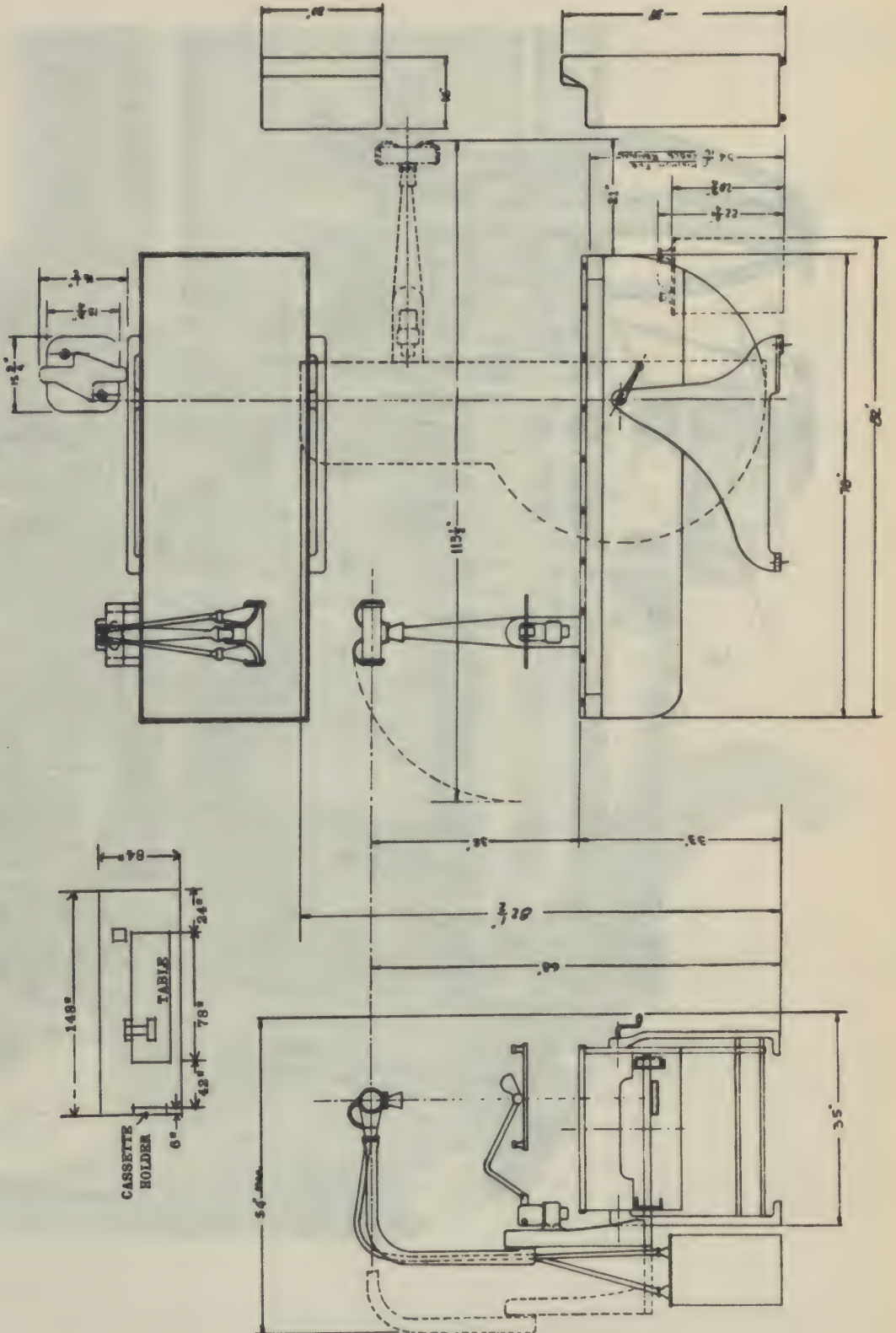
7. Replace the rear pivot bearing #57 Fig. 3 through the head on the inside of the table body, keeping the spring washer between the table body and the rear leg, with the external diameter bearing against the face of the leg. Replace nuts and tighten securely. Replace the front pivot with its head on the outside as shown in #58 Fig. 1 and the spring washer between the body and the front leg as described above. Replace the key washer over the pivot on the inside of the table body and with a heavy screw driver tighten the pivot into the driving mechanism housing until the hole in the housing, the key washer, and the tapped hole in the table body line up. Be sure that the front pivot has been securely tightened. Now by means of a small screw driver, push the drive shaft on the inside of the pivot #58 Fig. 1 through from the front until the threaded end is just flush with the outside of the driving mechanism housing. Replace the ratchet with the flares of the teeth

MOTOR DRIVE AND HAND TILT MODELS



FIG. 1

SPACE AND WEIGHT DATA FOR "CENTURY" UNIT



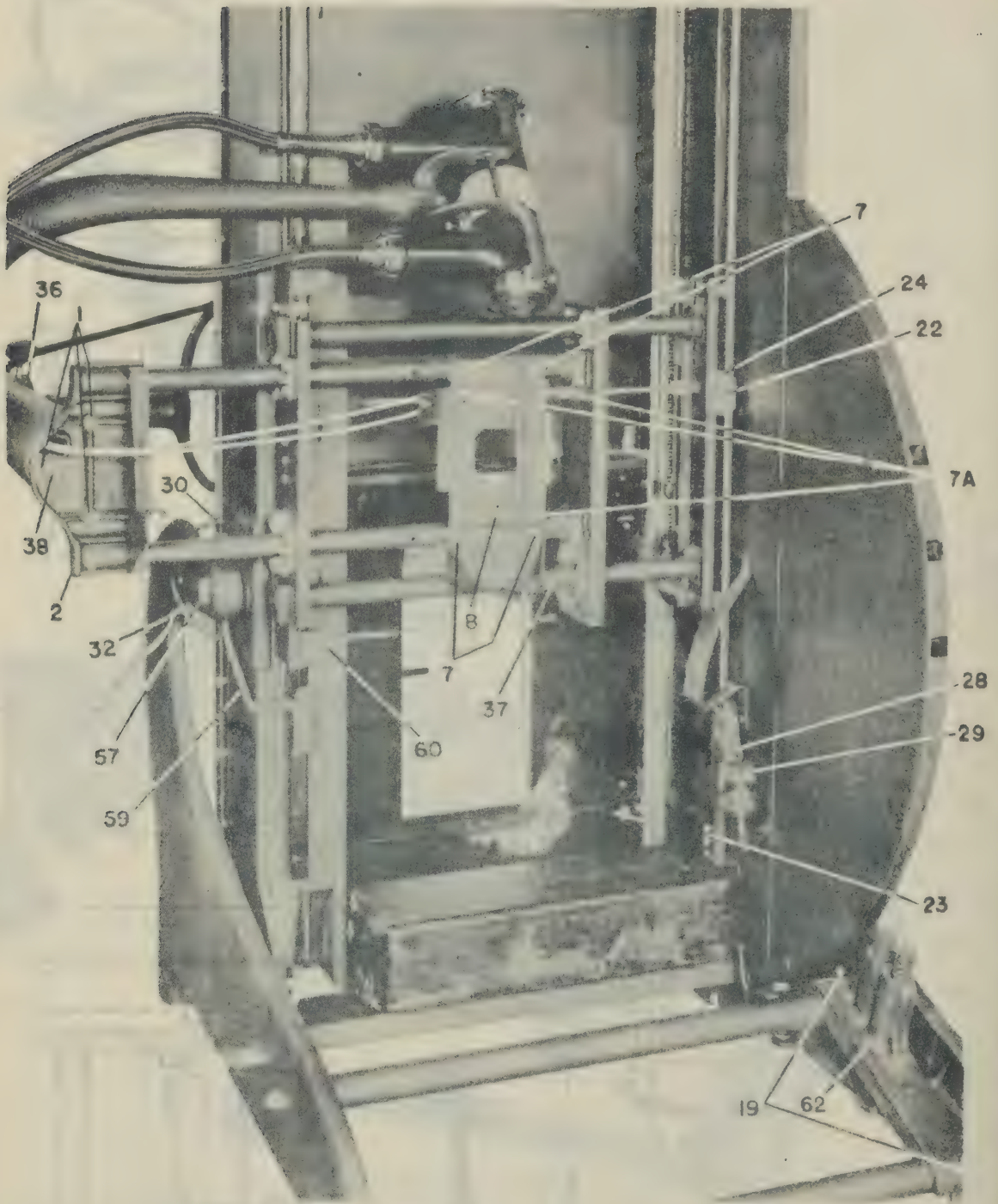


FIG. 3

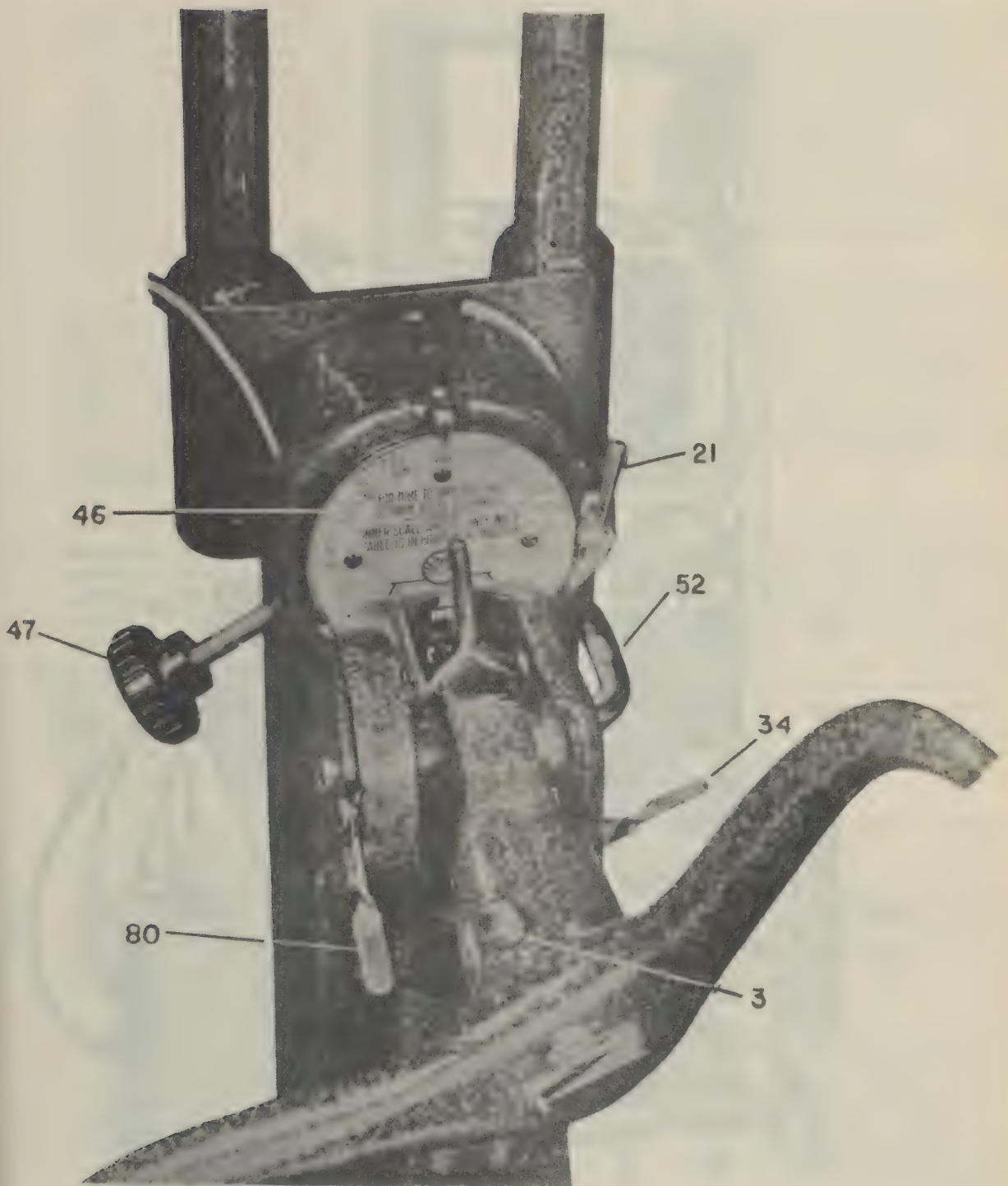


FIG. 4

MOTOR DRIVE AND HAND TILT MODELS

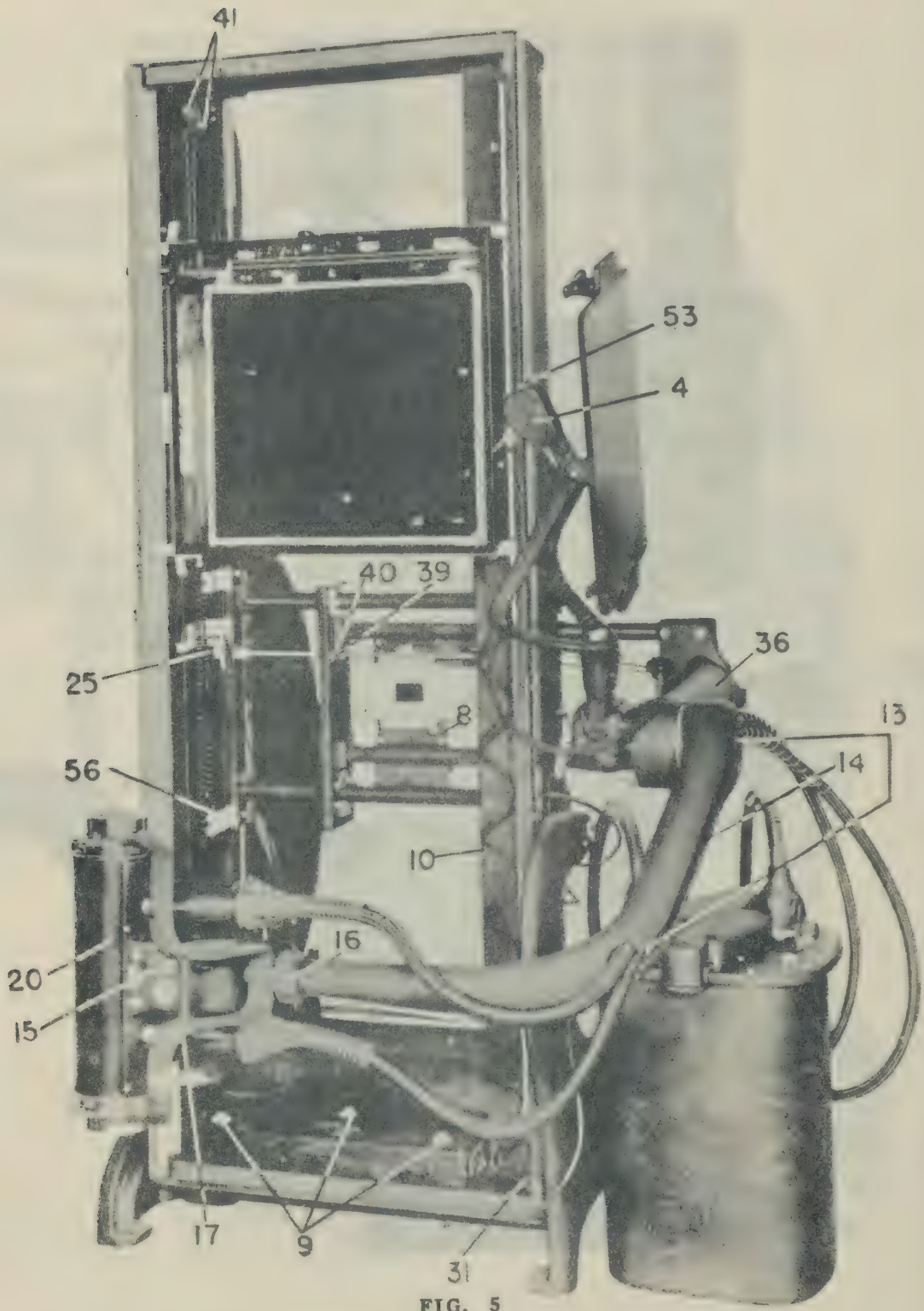


FIG. 5

MOTOR DRIVE AND HAND TILT MODELS

clockwise, replace the drive gear, clutch face up, and screw on the clutch face until there is a minimum of play between the clutch face and the drive gear. Replace the pin, snap ring, and the 10-32 screw with the retaining clip under the head. The retaining clip must be in place, otherwise the clutch assembly will be forced out with the crank, causing the Bucky to fall when the table is in the vertical position. Before the table is tilted, it is advisable to attempt to move the Bucky toward the foot of the table without operating the drive crank. If the Bucky is locked in this direction, but can be moved towards the head end, then the clutch has been properly assembled. If the Bucky can be moved to the foot end of the table, then the ratchet is on backwards and must be corrected. The table top should be left off until the foot end counterweight and fluoroscopic shutters are installed as outlined in paragraphs 12 to 18.

8. If the door is less than 31" in width, then the horizontal carriage must be removed. Proceed as above by removing top, and base assembly. However, before this is done, the horizontal carriage should be removed. Disconnect the counterbalance cables at either end of the weight. After the Bucky chain has been removed, remove the two bearings #60 Fig. 3 at either end of the rear horizontal carriage and remove the carriage from the table. Be extremely careful about marring the finish of any parts. THE COUNTERWEIGHTS MUST BE LOCKED IN POSITION BY MEANS OF THE LOCKING SCREW #10 Fig. 5 BEFORE ANY ATTEMPT IS MADE TO TILT THE TABLE OR MOVE IT THROUGH A DOORWAY.

9. ASSEMBLY OF TUBE STAND - The tube stand support is packed with the diaphragms, tube stand and screen counterbalance housing. Extreme care should be observed in unpacking this assembly when attempting to rotate the tube stand in the support, #36 Fig. 5, since the tube stand is spring counterbalanced and without the weight of the x-ray tube and the cables the arm is apt to open with great speed and injure the mechanism or the assembly. It is best to install the tube stand and its support as received. Remove the three nuts and lock washers #1 Fig. 3 from the studs of the tube stand support, #36 Fig. 3. If any shim washers are present be careful that they remain on their respective studs between the tube stand support and its mounting bracket. Insert the studs of the mechanism carefully into the holes of the bracket #2 Fig. 3, replace the lockwashers and nuts. Draw the nuts up firmly being careful not to strip the threads in the tube stand support.

10. ASSEMBLING TUBE STAND TO ITS SUPPORT - If the tube stand is not mounted to its support when received it will be necessary to assemble it as follows:

Remove the four hex head cap screws, lockwashers, and index plate from the back face of the counterbalance housing. Insert the cap screws with lockwashers into the four holes of the tube arm, place the index plate #46 over them as shown in the illustration Fig. 4, and tighten the screws firmly, being careful not to strip the threads in the counterbalance housing.

11. ATTACHING THE SCREEN - Loosen the retaining screw #3 Fig. 4 on the screen hanger until the pivot hole is clear. Note that the casting to which the screen hanger fits has a groove, machined around its diameter, and in the bottom of the groove are two fillister head screws. The above mentioned retaining screw fits down in this groove holding the screen hanger in place, and the two small screws in the groove act as stops to limit the rotation of the screen. Be sure that the screen hanger has been forced all the way down on the pivot casting and that the screen is in the correct operating place before tightening the retaining screw.

12. INSTALLATION OF DIAPHRAGMS AND DIAPHRAGM CONTROL - The diaphragms and the diaphragm control cables #4 Fig. 5 are shipped attached to the tube stand.

MOTOR DRIVE AND HAND TILT MODELS

Take care during the assembly that the control wires do not mar the finish of any associated parts.

13. Remove the four screws #5 Fig. 1 in the shutter control lever housing and screw the housing to the screen fork. Notice that the arm of the screen fork on the side to which the housing is fastened is grooved on the under side. The control cables in their protective sheathing should be placed in this groove and retained by means of the screw at #6.

14. Before attaching the shutters, tilt the table to the vertical. This must be done carefully since the table is unbalanced and the head end will tend to fall. It should be left in the vertical until after the foot end counterweight is installed. Remove the four screws #7 Fig. 3 from the under side of the center rails of the horizontal carriage. Place the pan #8 Fig. 3 in position over these holes with the offset down as shown, and fasten temporarily in position with the screws.

15. Operate the diaphragm control levers and see that the shutters close and open completely. For adjustments (if necessary) see Paragraph #37.

16. ATTACHING FOOT END COUNTERWEIGHT - With the table top removed and the table in the vertical position, the foot end counterweight can be installed.

17. Move the foot end counterweight to the front of the table with the heavy section next to the table and facing up. With sufficient help and a crowbar, or hooks inserted into the holes or slots provided, lift or pry the weight into position. The counterweight is secured to the table with three 1/2-13 hex head cap screws #9 Fig. 5 with a large flat washer under the head. Tighten these screws securely. Replace table top and tilt back to horizontal.

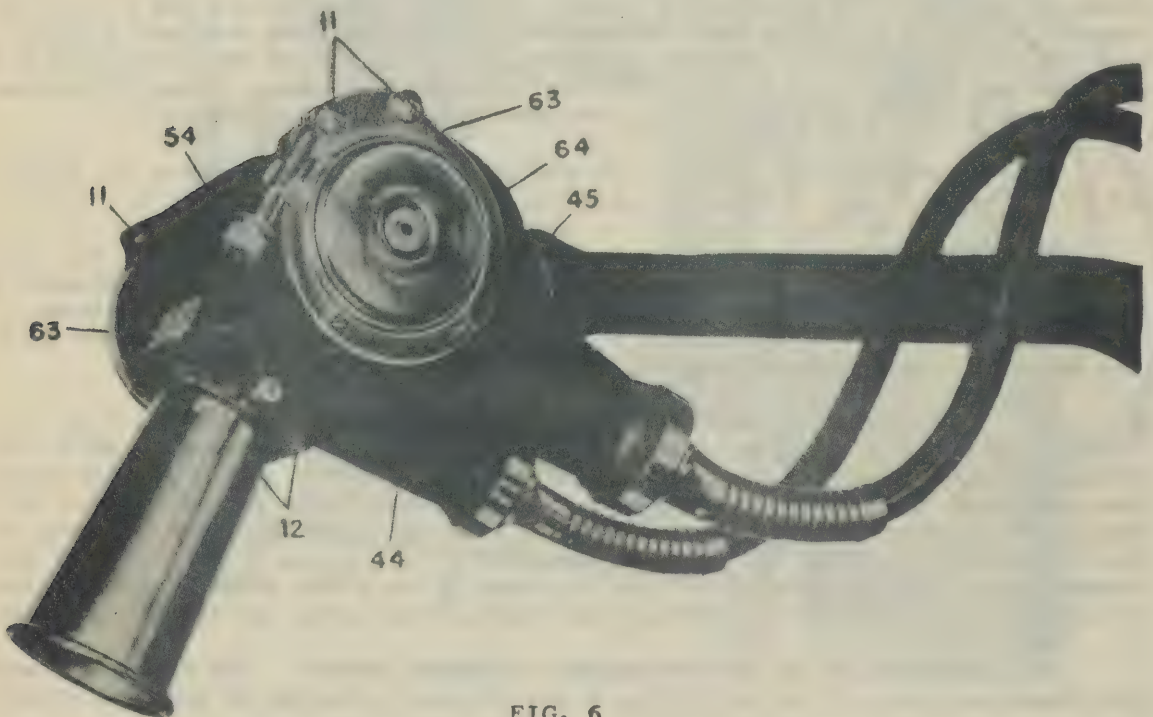


FIG. 6

MOTOR DRIVE AND HAND TILT MODELS

18. **COUNTERBALANCE LOCK** - The fluoroscopic carriage counterweight is locked in position for shipment by means of hex.head screw through the side of the counterweight housing at #10 Fig. 5. To unlock the counterweight simply remove this bolt. If for any reason the table is ever moved or shipped, this weight must be locked. The horizontal carriage should move freely over its entire range on the table.

19. **MOUNTING X-RAY TUBE ON TUBE STAND** - Mount the tube support rings on trunnions #63 Fig. 6 to the tube hanger #64 Fig. 6 by means of the screws #11 as shown, leaving the screws loose.

Then insert the bearing ends of the x-ray tube into the trunnion on the tube hanger, and tighten the screws #11 securely.

20. Screw the cone support #12 Fig. 6 to the tube by means of the four screws furnished as shown in Fig. 6.

21. **ATTACHING SHOCKPROOF CABLES** - Place the transformer on the floor as shown in the illustration.

22. In order to install the high tension cables, remove the cable clamps by means of the two screws at the back of the tube stand #13 Fig. 5. Insert the cable terminations in the tube housing and insert the cable in the slot #14 Fig. 5 of the tube stand, allowing sufficient loop between the tube and the entrance at the tube stand. Approximately 37" of loop should be provided. Lay the cables in the groove provided for them in the tube stand and replace the upper cable clamp and tighten the screw. It will be noticed that the cables have springs which limit the radius the cable can assume when the tube stand is rotated. Each spring has a long termination at one end. These terminations should be arranged on either side of the tapped hole for the lower cable clamp and the clamp placed over them in such a manner that the spring termination will be between the tapped hole and the turned down flange of the clamp. The clamp should be placed so that the flange will face the table and be on either side of the boss in the tube stand. Then the spring cannot pull out since one side is held by the screw and the other side by the flange on the clamp. Tighten the clamp screw securely.



FIG. 7

23. Care must be exercised before putting the high tension cables into the insulators of either the tube or the transformer. Be sure that all the surfaces of cable terminations are clean. The inside of the insulators should be inspected, and if they are not absolutely clean, they should be thoroughly wiped out. The cathode and anode shockproof cables are different. Care must be taken to match the cable terminations at both the x-ray tube and transformer.

24. **TRANSFORMER ON WALL BRACKET** - Fig. 7 shows the suggested position for the transformer wall bracket when it is desired. The bracket should be securely fastened to the wall with the lag screws or toggle bolts furnished depending on the wall construction. In no case should the transformer top be placed closer than 17" from the ceiling to allow clearance for removing the cables. If the transformer is mounted more than 78" from the floor, or in any

MOTOR DRIVE AND HAND TILT MODELS

position other than shown, special length shockproof cables may be necessary.

25. If the transformer is mounted at any other position than shown previously check the motions of the tube and the tube stand to see that the cables can be moved to all positions without strain.

26. If the transformer is placed on the floor in any other position than shown in Fig. 2, it will be necessary to check the relative position of all parts of various positions of the table to make sure none of the assemblies interfere with adjacent assemblies.

27. TABLE-FINAL POSITION - It is desirable to bolt the table to the floor. This will result in a decided increase in the rigidity of the complete unit. Lag screws are supplied for this purpose and should be applied through the four holes in the base casting. Of course, this should not be done until the table is completely assembled, checked, and its final position definitely ascertained.

28. MOTOR DRIVE CENTURY - The installation of the motor drive Century unit is exactly the same as that for the hand rock Century except that the motor supply line must be connected. To do this, remove the cover #74 Fig. 8 and connect the motor line cable at the terminal panel #70, and clamp it by means of the clamp at #71. Replace the cover #74, making sure that all screws are drawn up securely. It would be well at the time of installation to add a few drops of a good grade of machine oil to the motor. A few drops of oil should be added to the motor every six months.

29. ADJUSTMENTS-SCREEN COUNTERBALANCE SPRING - If the screen is unbalanced, then loosen the cap nut #33 Fig. 1 and tighten or loosen the nut between the cap nut and the counterbalance housing until the screen is properly balanced. Tighten the cap nut against the adjusting nut.

30. SCREEN PIVOT LOCK - If the screen pivot lock #34 Fig. 4 fails to engage automatically and positively in both positions over the table and away from the table, then remove the set screws at #35 Fig. 4. Keep the screen over the table and adjust the set screw found under the one removed, until the lock #34 engages properly and positively. Swing the screen to the rear of the table and adjust the screw at #35 Fig. 4 as outlined. Replace the set screws and tighten firmly. If the screen is not parallel with the head end of the table, loosen the three nuts #1 Fig. 3 and swing the screen in the proper position. Tighten these nuts securely. If the tube stand does not stand perpendicular to the table top and is not centered over the Bucky, then remove the nuts #1 Fig. 3 and place shim washers (see Paragraph 9) between the tube stand support #36 Fig. 3 and the bracket #2 Fig. 3. These washers must be 3/4" O.D. or less.

31. CENTERING X-RAY TUBE WITH SCREEN - Place the table in the horizontal position. Loosen slightly all the screws #7 and #7-A Fig. 3. Place x-ray tube in fluoroscopic position as described in Paragraph 49 and position the shutter support plate until the tube is approximately centered with the slots of the diaphragms. Check and make all final adjustments fluoroscopically. When the final position of the shutters has been determined, then tighten the screws #7 and #7-A and adjust the bumper #37 Fig. 3 against the tube and lock firmly. Recheck fluoroscopically with table in horizontal and vertical.

32. TUBE STAND COUNTERBALANCE - If the tube stand is unbalanced as it is brought under the table from radiography to fluoroscopy, adjust the nuts #38 Fig. 3 accordingly. BE SURE, AFTER ADJUSTMENT, THAT THESE NUTS ARE TIGHT.

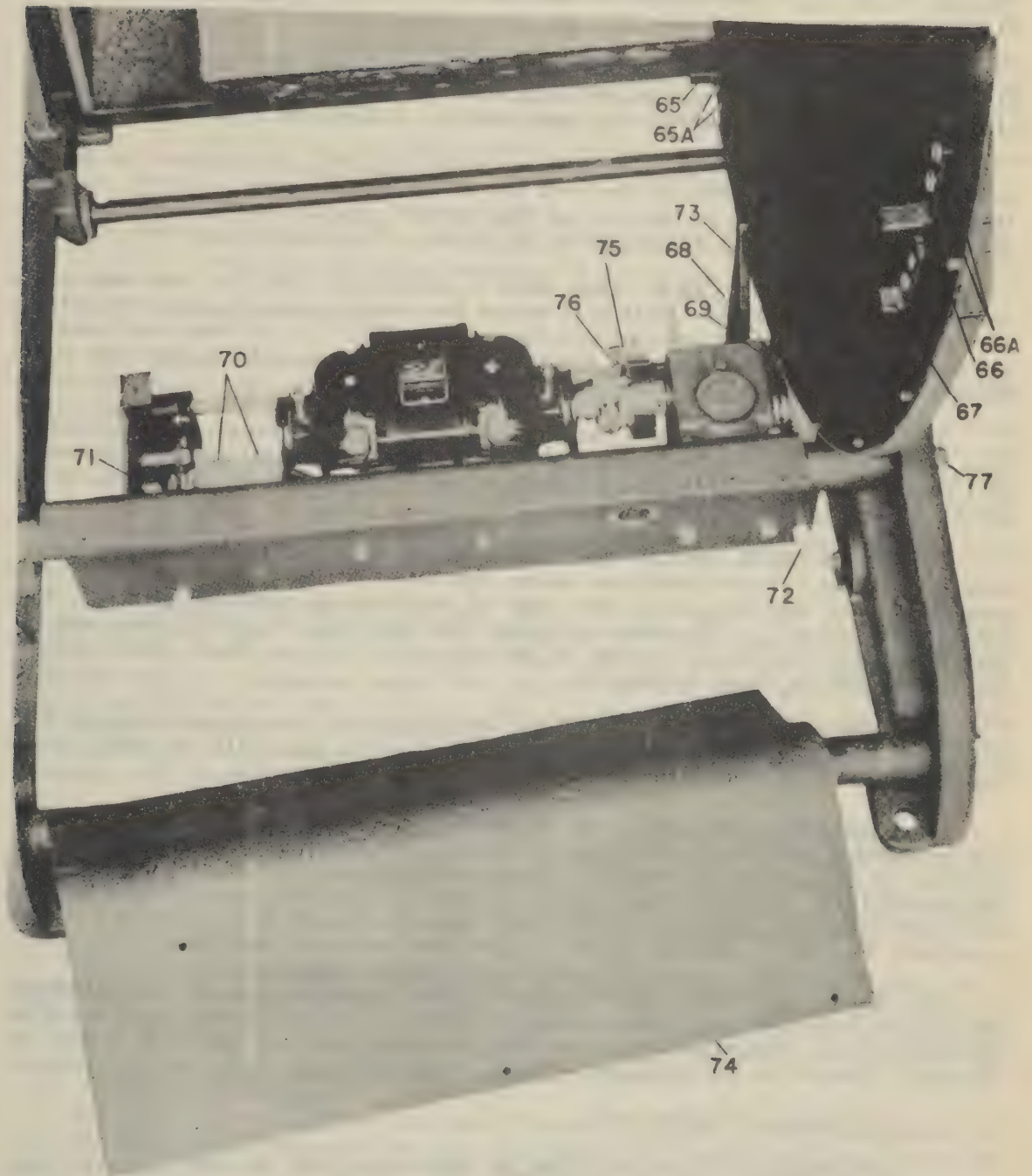


FIG. 8

MOTOR DRIVE AND HAND TILT MODELS

33. TRAVEL LOCKS - For the adjustment of the longitudinal lock, loosen the nut at #25 Fig. 5 and adjust the slotted screw until the lock operates easily. Tighten lock nut.

34. For the adjustment of the lateral lock, loosen the two screws at #39 Fig. 5 and move the lock housing #40 Fig. 5 in the serrated plate, one notch at a time until the proper adjustment has been secured. Tighten the screws.

35. BUCKY CHAIN - If it should be found desirable to tighten the Bucky lifting chain, the sprocket at the head end of the table can be adjusted. Loosen the two nuts #41 Fig. 5 on the side of the sprocket housing and move the housing back, until the slack is removed from the chain. Then tighten the nuts firmly.

36. COUNTERWEIGHT CABLE - Keep table in horizontal position, and move carriage to foot end of table. This will expose the counterbalanced cable termination at the underside of the counterbalance housing #42 Fig. 1 at the head end. Adjust the nuts accordingly but be sure that the cable is not too tight, lock the nuts against one another.

37. SHUTTERS - To adjust the shutters, turn the fittings of the shutter wire terminations inside the housing #4 Fig. 5. A slight adjustment at this point will usually be found sufficient although it may be necessary to adjust the screw #53 Fig. 5 for final position of levers.

38. MOTOR DRIVE CENTURY-VERTICAL POSITION - If the tilt table does not stop in the true vertical position, loosen the screws at #65A Fig. 8 and shift the stop #65 toward the foot end of the table if the table is short of vertical, and toward the head end if the table is beyond the vertical. Several trials may be necessary before the final position of the stop #65 Fig. 8 is found. Be sure that the screws #65A are drawn up securely.

39. TRENDLENBERG POSITION - If the table does not stop at approximately 11° below horizontal for Trendelenberg, then shift the stop #66 until the table stops correctly, and be sure that the screws #66A are drawn up securely.

40. HORIZONTAL POSITION - If the table stops consistently below or above the horizontal position regardless of whether the table is operating from the vertical to horizontal or from the Trendelenberg to horizontal, then adjust the horizontal lever stop #67 Fig. 8 until the head of the table stops 33-1/4" above the floor without a patient. If the table is made to stop a little high without a patient, then with a patient it will stop at the horizontal position.

41. If the table stops below horizontal when coming up from the Trendelenberg position or above horizontal when coming down from the vertical, or vice versa, then the #10-32 Allen head adjusting screws #68 and #69 in the lever #73 Fig. 8 must be adjusted. Proceed in the following manner:

(a) Remove the cover #74.

(b) Remove the first set screw in each hole at #68 and #69.

(c) If the head of the table stops below 33-1/4" when coming up from the Trendelenberg position, then back out the screw #69 until the head of the table stops at 33-1/4" without a patient. If the table stops above 33-1/4", then turn the screw #69 clockwise until the table stops correctly. Replace the set screw removed and tighten securely.

MOTOR DRIVE AND HAND TILT MODELS

This second set screw acts as a locking screw. Recheck the operation of the table.

- (d) If the head of the table stops above 33-1/4" above the floor when coming down from the vertical or intermediate positions, then back out the screw #68 until the head of the table stops at 33-1/4". If the table stops below 33-1/4", then turn the set screw #68 clockwise until the head of the table stops at 33-1/4", replace the locking set screw and tighten securely. Recheck the operation of the table.
- (e) After the screws at #68 and #69 have been adjusted, it may be necessary to recheck the vertical and Trendelenberg positions and reset the stops #65 and #66 as outlined in paragraphs 38 and 39.
- (f) Replace the cover #74.

42. BRAKE ADJUSTMENT - If the table has a tendency to coast, particularly with a heavy patient, then the brake must be adjusted. Remove the cover #74 Fig. 8 and loosen the nut at #76 and back out the screw at #76 bearing against the brake lever #75. Usually about one-half turn of the screw will be sufficient. Be sure that the lock nut at #75 is tightened and check operation of the table. Extreme care must be observed in making this adjustment so that the screw is not backed out so far as to cause the motor reversing switch to remain closed when removing the foot from the foot pedal. See that the contact surface between the screw and brake lever #75 is greased.

43. MESHING OF PINION GEAR AND RACK - If the spur gear is not properly meshed with the rack, then loosen the cap nut at #77 Fig. 8 and adjust the nut #72 against the motor support plate until the rack and gear are properly meshed. Turning the nut clockwise causes the gear to go into mesh with the rack, and loosening the nut will cause the spur gear to go out of mesh with the rack. This nut should be adjusted until as much of the spur gear tooth is in mesh with the rack as possible without binding. Be sure that the nuts at #72 are securely locked against each other. Tighten the cap nut #77.

44. GENERAL OPERATING INSTRUCTIONS - We suggest a careful study of the following with the belief that it may greatly simplify the operation of the apparatus. With reference to the mechanical portion of the equipment--the table, fluoroscope, and tube stand, we would suggest a very definite procedure for placing the tube, screen, the Bucky, and the table in its various positions.

45. TILTING THE TABLE-MOTOR DRIVE CENTURY - The motor drive Century tilt table is equipped with an automatic horizontal leveling feature. The table can always be caused to stop horizontally, regardless of whether the head of the table is coming up from the Trendelenberg position or down from the vertical or any intermediate position when the foot pedal is depressed.

46. In order to operate the table from the vertical through horizontal to Trendelenberg, it is necessary to press the foot pedal forward with the toe of the shoe before depressing the pedal. This operation can also be performed by depressing the pedal and allowing the table to stop at the horizontal position, then pressing forward on the pedal and depressing it will allow the table to run down to the Trendelenberg position. The opposite is also true for the operation of the table from the Trendelenberg to the vertical or any other intermediate position.

47. This action can be explained in the following manner: #65 and #66

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Fig. 8 are the final position stops for the vertical and Trendelenberg positions respectively. #67 is the horizontal position stop and its length projecting from the segment of the table is less than either the vertical or Trendelenberg stops, therefore, if the foot pedal is depressed the stops #65, 66 and 67 act against the lever #73, which cuts off the motor supply source. However, if the pedal is pressed forward, the lever #73 is made to clear the horizontal stop #67 and the table will operate between the vertical and Trendelenberg positions, or stops #65 and #66. A spring always returns the foot pedal to the original position so that lever #73 always engages with the horizontal stop #67.

48. **TILTING THE TABLE-HAND TILT CENTURY** - When the table is in the horizontal, and the tube in the radiographic position as shown in Fig. 1 and if it is desired to place the tube in the fluoroscopic position, the screen should be positioned over the table and the carriage moved to the extreme head end of the table. The axis of the tube should be placed in the horizontal plane, that is the scales #44 and #45 Fig. 6 should be set at zero, and the lock #54 Fig. 6 tightened, and the radiographic cone removed. The tube stand can now be unlocked at #21 Fig. 4 and the tube stand with the tube rotated into the fluoroscopic position. If the tube is rotated incorrectly, that is, the tube is not in the proper position in respect to the tube stand or the carriage mechanism is not at the extreme head end of the table, it will interfere in passing under the table. After the tube is under the table, the screen can be swung away from the table to position the patient.

49. To simplify the positioning of the patient, we strongly recommend that the habit be formed of unlocking the pivot #34 Fig. 4 and rotating the screen rather than raising the weight of the screen.

50. Fig. 4 shows the screen counterbalance housing with the stepless compression lock. In order to operate the lock depress the lever 80 Fig. 4 as shown. This places the locking pawls in the "lock position" and prevents the screen from being raised. To release the lock lift the lever "80" as far as it will go, thereby releasing the pawls and freeing the screen for movement to and from the table top. In order to release the compression lock under a high degree of compression it may require a slight downward movement of the screen toward the table top.

51. **OTHER FLUOROSCOPIC POSITIONS** - If fluoroscopy is to be done in any position other than horizontal, the above procedure should be followed just as described. Then with the Bucky at the foot end of the table in hand tilt models and *with the screen placed over the table top in the fluoroscopic position and locked*, the table can be tilted to any of its four positions.

52. **HORIZONTAL RADIOGRAPHY** - If the table is in the horizontal position, and the tube is under the table in a fluoroscopic position, and it is desired to bring the tube over the table for radiography, it is only necessary to rotate the tube stand, but if the table is in any other than the horizontal position, the Bucky should be moved to the foot end of the table in hand tilt models and the table should be tilted to the horizontal before attempting to bring the tube from under the table to a position over the table. In hand tilt models it is not absolutely necessary to have the Bucky at the foot end of the table to tilt the table from the Trendelenberg or Fowler position to the horizontal. However, if the Bucky is at the foot end, the unit is in balance and the change in position can be made more easily. The radiographic cone can now be installed.

53. With the table in the horizontal, and the tube stand in the vertical over the table, a focal distance of 37" exists between the Bucky and the focal spot of the tube. If it is desirable to work at a focal distance of 30", the tube stand

can be set either to the right of the vertical or the left of the vertical. There are three index points at the tube hanger which correspond to the 30 and 37 inch focal distance of the tube. When the tube stand is angulated to either the right or the left "30" focal spot to Bucky "position" these indices indicate the horizontal position of the tube axis. As viewed from the front of the table, the operating side, a stop is provided so that the tube stand will not go beyond the proper position when tilting it to the right. When tilting it to the left of the center, it is necessary to stop at the index locked position.

54. The operation of tilting the tube stand either side of center can best be performed from the rear side of the table. It can be done with the screen positioned over the table, or rotated clear of the table, but the screen should not be raised away from the table top. The scale #46 Fig. 4 indicates the Bucky focal distances and also the vertical distance of the tube to the floor. If it is desirable to work at focal distances other than 30" or 37", the tube stand must be locked by means of the lock knob #47 Fig. 4.

55. The extreme ends of the table top can be reached with the tube, by working at the 30" focal distance and swinging the tube stand either to the right or the left depending upon which part of the body the radiograph is to be made.

56. SINUS POSITION - The angulation of the arm permits sinus work at the head end of the table. This can be accomplished by angulating the tube to the left, and moving the carriage to the extreme head end. The patient can then be positioned facing the foot of the table and the tube properly localized.



FIG. 9

57. BUCKY CENTERING DEVICE - After the tube has been properly positioned, to the desired radiographic position, the Bucky can be moved to the proper position by means of the crank #45 Fig. 1 on the operating side of the table. The lever #49 Fig. 1 at the right hand side of the Bucky, when pulled down, places the centering device in the engaging position. The Bucky is driven to the desired position by means of the crank. When the two fingers of the centering device center with the two notches #50 Fig. 1 on the carriage, the Bucky is centered with the tube stand for the vertical position, or 37" focal distance. If facing the operator's side of the table, the finger on the lever side of the Bucky engages with the notch on the right side of the carriage, as shown in Fig. 1, then the Bucky is centered for the x-ray tube when it is at the 30" focal distance to the right, and vice versa. It is now possible to move the tube stand and the Bucky as a single unit by turning the crank until the proper relationship with the patient is obtained. Be sure that the travel lock #51 Fig. 1 is unlocked when moving the assembly in unison. To disengage the Bucky from the tube stand, lift up the lever #49 Fig. 1.

58. CHEST OR VERTICAL STOMACH WORK - With the table in the horizontal and the tube under or over the table, it may be desired to properly position the tube in relationship with the patient and the cassette holder mounted on the wall for either stomach or chest work. For stomachs, proceed by placing the cassette in the wall mounted holder, (Fig. 9) raising or lowering it until the height coincides with the location of the stomach of the patient. Then note the vertical dimension of the cassette being used. Read the scale #55 Fig. 9 under

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that vertical dimension of cassette. The distance indicated is then the center of the cassette to the floor. Returning to the tube stand, move the fluoroscopic radiographic assembly to the extreme head end. Rotate the tube stand above the table top and rotate the x-ray tube to point toward the cassette holder and set the scale #44 Fig. 6 on zero. Then position the tube stand such that the scale #46 Fig. 4 reading inches to the floor coincides with that read on the cassette holder. Then retain this position by tightening the lock knob at the pivot of the tube stand. A slight lateral adjustment of the fluoroscopic radiographic carriage may be necessary in order to align the target with the center of the cassette. A notch is provided in the carriage cross rail and a slight bump may be felt which indicates that the carriage and the x-ray tube is at the center of the table. The desired focal distance to the wall can then be obtained by moving the fluoroscopic radiographic carriage in the table. If desired, a mark can be made on the operating side of the table to coincide with the lock handle #52 Fig. 4 which will establish the desired focal distance for future use. The above procedure can be followed for both chest and stomach work.

59. VERTICAL STEREO WORK - With the table in the horizontal, rotate the tube until its axis is perpendicular to the tube stand and rotate the tube stand with the tube under the table. The tube port will then face directly away from the table top. It is not necessary to remove the cone. With the tube in this position, tilt the table to the vertical and move the horizontal carriage laterally to align it with the center of the cassette holder or cassette changer. The vertical position of the tube will have to be adjusted to meet the center of the cassette. With the tube in this position vertical radiographs may be taken with or without the stereo shift, without having the radiation pass through the table top.

60. VERTICAL RADIOGRAPHY - For vertical radiography, it is necessary that the screen be moved away from the table in order to stand clear of the tube. Before tilting the table, position the tube stand to the right or left, or at the center depending upon which part of the body a radiograph is desired, and depending also upon the focal distance. It is not advisable to work at any other focal distance than 30" or 37", at which points the plunger lock #21 Fig. 4 operates.

61. After the tube stand position has been determined and locked, the screen should be moved away from the table as far as it will go, and when raised or lowered, a pronounced click will be heard. This is an automatic lock which locks the screen so that it can not swing on the counterbalanced pivot when the table is tilted to the vertical. Be sure that the lock #34 Fig. 4 definitely engages the screen swivel before the table is tilted.

62. Now with the screen in the clear and locked, the tube stand at the proper angle, and the Bucky at the foot end of the table, the table can be tilted to the vertical. The Bucky can again be raised to engage in the proper position with the tube stand as outlined above, and the unit moved to the proper relation to the patient.

63. VERTICAL FLUOROSCOPY - For vertical fluoroscopy, place the tube in the fluoroscopic position with the table in the horizontal as described in Paragraph 48, and with the screen over the table and locked, tilt the table to the vertical. To disengage the screen counterbalance, pull the screen as far as it will go away from the table top and hold the lever #52 Fig. 4 away from you toward the table top, and while depressed move the screen toward the table. If this operation is properly performed, it will be found that the screen will swing to and from the patient freely and without any counterbalance action. To restore the counterbalance action, and before the table is tilted to the horizontal, the screen

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must again be moved as far away from the table top as it will go without depressing the lever #52 so that the counterbalance mechanism can re-engage.

64. **OPTIONAL ADDITIONAL EQUIPMENT-HORIZONTAL STEREO-SHIFT** - Remove the lock bracket #22 Fig. 3 and fasten the shift rod and mechanisms through the two holes found at either end of the track #23 Fig. 3. The spring mechanism must be at the foot end of the table as shown in Fig. 3. Replace the bracket #22 making sure that the lip engages properly with the compression stamping #24 Fig. 3. Loosen the lock nut #25 Fig. 5 and back out by means of a screw driver the slotted screw in the housing unit the shift rod is just locked to the carriage. Tighten lock nut #25 Fig. 5.

65. Figure 3 shows both the hand and magnetic trip release. For the hand release cord termination, drill and tap an 8-32 hole in the top of the front casting at #27 Fig. 1. Screw the eye furnished into this hole, pass the cord through and fasten to trip lever #28 Fig. 3.

66. For the addition of the magnetic release, loosen the screws #29 Fig. 3 and insert the magnetic release as shown, tighten these screws up firmly. Drill a 21-32 diameter hole just 1" to the right of the Bucky contact cable bushing as shown at #30 Fig. 3. Insert the bushing furnished. Install the cable passing either under or over the foot end counterweight and without much slack to the coil termination, clip the cable as shown at #31 Fig. 5. Pass through the cable bushing with no slack between the clip and the bushing. Clip to the two screws on the under side of the rear leg as shown at #32 Fig. 3. Be sure there is sufficient slack between the cable bushing and the first clip just beneath the pivot of the rear leg.

67. **ADJUSTABLE STEREO-SHIFT** - There is an optional stereo-shift which has an adjustable range from 2 to 8-1/2 inches in 1/2 inch steps. This is attached onto the end of the table body by three screws. If it is attached in the field, instructions are provided for drilling the necessary holes for mounting.

68. **TRAVEL LIMIT STOP** - There is an automatic stop provided which allows for maximum longitudinal travel, and prevents the tube stand from striking the rear leg. It will be noticed that as the carriage is moved to the foot end of the table and approaches the rear leg, it will move out of the way. This, of course, is only when working with the tube as far to the front of the table as possible.

69. There is also provided an automatic stop #59 Fig. 3 which allows maximum travel of the tube in the horizontal position, and limits the travel slightly for the vertical position to prevent the tube stand from striking the top of the rear leg or injuring the transformer.

70. **"DON'TS"** - Although the above has covered all the positions of the unit, the following "don'ts" might be easier to remember. Please understand that if the previous instructions have been observed, the following is automatically taken care of.

71. *Don't* under any circumstances attempt to rotate the tube from the fluoroscopic to the radiographic position, with the table in the vertical position.

72. *Don't* tilt the table from vertical to horizontal without having the screen counterbalance engaged.

73. *Don't* attempt to place the tube under the table or over the table when the table is in Trendelenberg. Put the table in horizontal.

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74. *Don't* tilt the table from the horizontal, with the tube stand under the table, into the vertical position until you are sure that the screen has been rotated and locked.

75. *Don't* tilt the table into the vertical with the tube stand over the table until you are sure that the screen has been rotated and locked away from the table, and has been raised or lowered until the automatic lock has engaged.

76. *Don't* attempt to place the tube under the table for fluoroscopy without first removing the cone and then being sure that the tube is turned until all scales at the tube read zero, which will place it in the correct position when it is finally under the table.

77. *Don't* expect the table to be balanced with the weight of the patient in hand tilt models. It requires considerable effort to tilt the table, thrown out of balance in this way.

78. *Don't* forget that this unit has been designed so as to permit the addition of various other convenient attachments, such as a variety of cones, stereo shifts with or without magnetic releases, adjustable seat, shoulder rest, and a number of other items which might facilitate your work.

79. *Don't* attempt to tilt the table to the vertical with the tube stand in the radiographic position and at the head end of the table if the ceiling is less than 88" in height. With ceilings of this height, always keep the tube stand away from the head end of the table before tilting.

80. *Don't* forget that the unit has been designed in a manner that permits the installation of the vertical counterbalanced tube stand, the exchange of the self-rectified transformer for a full wave, four-valve, oil immersed transformer with much higher capacity, enabling work at much higher speeds. Double focus tubes can be used with either transformer if they and the necessary auxiliary equipment are furnished.

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INSTRUCTIONS FOR INSTALLATION AND OPERATION FOR SERIES "200" TABLES WITH RAIL MOUNTED TUBESTANDS OR BIRAIL TUBESTANDS

GENERAL INSTRUCTIONS AND SUGGESTIONS - Carefully unpack the unit, leaving the valve tubes and x-ray tubes in their original cartons until everything else has been installed. The control is held in the crate by braces protruding through holes in the top of the cabinet. "Dot" plugs are provided to plug up these holes to prevent dust from entering the control during installation and operation of the control. These braces must be removed before the control can be taken out of its packing crate. After the transformer has been removed from its crate, it would be well to loosen one of the vent screws to allow for the expansion of the oil. The necessary cables for the connection of the unit will be found in a separate packing box.

Every care is exercised in the packing of the equipment to insure safe arrival. All finished parts are protected with a heavy wrapping of wax paper to prevent abrasion of painted surfaces.

A careful check should be made with the packing slip and the parts of the unit to be absolutely sure that no parts have been left in any of the packing cases. If shortages occur, they must be reported immediately. If the equipment shows any signs of external injury, the crates should be examined and the incident should be reported to the source from which the equipment was received, in the prescribed manner.

After the equipment has been carefully unpacked and checked against the packing slip, a plan of installation should be decided on. An accurate room layout or drawing should be made to locate each piece of equipment in the room so that they will not interfere with each other and so that no space shall be wasted. Such a layout should be planned to allow the shortest possible lengths of shockproof cable to be used. The pieces should be so placed to allow the maximum efficiency of operation and the minimum waste of time for the movement and handling of the patients. Probably the best procedure is to place the heavier pieces of equipment first, such as the transformer, tubestand, table, and control, before proceeding with any wiring.

These units are available in several models, both for single phase and three phase, in a variety of kilovoltage and milliamperage ratings, some of which are indicated in the illustrations. Most of these instructions apply generally to all models. Other sections are devoted to specific types. It is therefore advisable to read carefully the general section, and then locate the section applicable to the model at hand.

MOUNTING OF BIRAIL TUBESTAND - After the position of the floor track has been accurately located, the upper rail should be mounted on the ceiling with the five brackets furnished. The method of fastening these brackets will depend on the construction of the ceiling. If it is of concrete or similar substance, expansion shields and lag screws should be used; if it is wood and plaster then large wood or lag screws may be used.

For maximum rigidity place the ceiling brackets as shown in C-16366 (attached) so that the middle bracket is parallel to the top rail and the other brackets are at 90° to the top rail. The top rail can now be bolted to these brackets with the bolts and nuts furnished as shown in the attached drawing C-16366.

The floor track can now be securely fastened to the floor by means of the Rawl plugs and the wood screws furnished. In locating the position of this floor track, it will be necessary to drop a plumb line from each end of the ceiling track and

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then measure over 4-1/4 inches as shown in C-16366 for the accurate location of this floor rail.

If wall brackets are supplied, it will be best to fasten these to the wall first, and then locate the floor track in respect to the upper rail. Fasten the plates with the studs welded to them securely to the wall by means of the toggle bolts furnished. The brackets should then be applied directly to the wall plates (See Figure C-16366.)

ASSEMBLY OF THE BIRAIL TUBE STAND - When removing the birail tubestand from its long crate, it will be necessary to be careful not to tip the tubestand so that the foot end is higher than the top end of the tubestand to prevent the counterweight from sliding in the tubestand. If this happens the counterweight chain may come off the top pulley casting and it will be necessary to inspect this before tipping the tubestand in an upright position.

Before raising the tubestand up, it will be necessary to first mount the top horizontal carriage. This carriage casting fits over the top pulley cap bearing and is retained in that position by means of the three retainer screws attached in the mailing bag. The spacer bears directly against the top surface of the bearing on the top pulley cap, then the washer is placed on top of the spacer and the screw tightens the assembly in place. It is essential that the carriage be mounted with the bearings towards the ceiling. The horizontal lock tube assembly should not be mounted on the tubestand until after it has been placed on the rails.

Before placing the bottom carriage assembly on the tubestand, it will be necessary to first unlock the counterweight by removing the lock screw through the mast at the lower end of the tube which projects beyond the bottom of the tubestand proper. The round rotation plate with the four indexing notches in its periphery has been fastened to the base carriage. Do not remove the fastening means until the base has been secured to the tubestand. This aligning plate should be positioned firmly up against the bearings in the tubestand before it is bolted in place on the lower tube. The location of the notches in the plate have been very accurately adjusted at the factory for correct positioning of the arm. This is done by means of the adjusting fingers fastened to the front and rear of the base casting. It should not be necessary to readjust this setting unless through careless handling the indexing notches have come out of adjustment.

The entire tubestand can now be raised in an upright position and lifted onto the lower rail. If the bolts holding the upper rail through the ceiling brackets are left loose, the upper rail can be lifted high enough to clear the bearings in the upper tubestand guide bracket, and then it can be dropped between the bearing and tightened at each one of the brackets after the tubestand has been moved from one end of the rail to the other to be sure that this upper rail is tightened in the correct position so that it will not bind anywhere along its length.

The tube arm may now be installed with the carriage at its topmost position. Do not attempt to lock the vertical carriage in the lower position with the vertical travel lock as it was not designed to hold the entire weight of the counterweight. The carriage may be held down, if necessary, by a 2 x 4 tied securely between it and the top casting, but the safest method is to assemble the arm into the vertical carriage in its highest position. The tube arm pivot post is inserted into the carriage casting, while the rotation locking clamp is carefully placed over the machined shoulder of the carriage casting so that the rotation lock knob will be against the short side of the locking clamp. The hexagon head screw should be put

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into the carriage casting so that it will engage the groove in the pivot post of the horizontal arm.

The horizontal lock rod can now be installed on the top rail. The horizontal lock tube has a loose locking insert at the tubestand end. The hole through which the horizontal shift rod passes has been kept in alignment by means of a screw placed through the tube and the insert for shipping purposes only. It is essential that this screw should not be removed until all is ready to place the tube in position in its receptable in the upper carriage casting. It will be best to immediately install the horizontal shift rod so that this alignment is not lost. Refer to the drawing No. C-16366 for the proper assembly of the shift rod and the accompanying mechanism. Note that the upper track assembly has been drilled so that the brackets for mounting the shift mechanism can be placed in either of two positions for a four inch or a seven inch shift, depending upon whether the stand is a standard height or the six-foot focal distance type.

The cable support brackets No. 8 Fig. B can now be mounted on the tubestand as shown. Mount one roller and clamp bracket on each side of the shield by means of the tapped inserts mounted on the sides of the shield. Care must be exercised to mount these brackets with the lower end of the cable clamp No. 46 Fig. B toward the front of the tubestand. It will be found best to remove the rollers from their shaft before attempting to mount the bracket on the side of the tubestand. Be sure to tighten the nuts firmly which lock the roller shaft in place. It will be desirable to leave the cable rollers off until the tube and high tension cables are being attached, otherwise the rollers will have to be removed at that time.

FLOOR TYPE RAIL MOUNT - The rail mount should be carefully unpacked and placed in its proper position on the floor as shown in Fig. E. The rear of the rail mount is placed with the lower nail on the outside. Moving the rails after the tubestand has been mounted is rather difficult, so that it is important to locate them in the exact location, being sure to leave the minimum space from the walls as indicated in Fig. E. The rails should be leveled by placing shims between the bottom of the rail mount and the floor. The bearings used to take the load on the tubestand are of the finest grade automotive type. The tubestand should roll with the very slightest pressure in either direction, if the rail mount has been properly leveled. Sufficient time spent on this leveling process will be warranted in the ease of operation obtained.

Lag screws have also been provided to fasten the unit to the floor. These are not actually necessary for stability, but it is found that bolting the rails to the floor will increase the rigidity of the tubestand. Wherever shims are used for leveling, it is desirable to pass the lag screw through the hole in the shim.

MOUNTING THE TUBESTAND ON FLOOR TYPE RAIL MOUNT - The lower casting No. 3, Fig. D has been turned 180° to facilitate packing in a standard crate. It will be necessary to loosen this base casting on the mast and turn the casting through 180° so that it will be in the position shown in Fig. D, directly in line with the back of the tubestand.

The two lower bearings on the carriage of the tubestand No. 1, and No. 2, Fig. C, should be removed before attempting to mount the entire tubestand. Do not, under any circumstances, remove the eccentric studs upon which the bearings are mounted. To remove bearings remove screw on face of bearings. When these have been removed, the entire tubestand can be carefully lifted from its crate, and placed on the rail mount, as shown in Fig. D. Sufficient help should be available for this

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operation so that the tubestand is now dropped or jarred while mounting it on the rails as it may cause serious damage to the ball bearings.

The two lower bearings should now be reassembled to the carriage. These bearings are mounted on eccentric bearing screws so that they may be adjusted to fit the diameter of the rail. Since they have been properly set at the factory, it should not be necessary to change them. These bearings should revolve freely along the entire traverse of the rail mount. If there is any binding anywhere along its length, the bearing eccentrics should be readjusted by pulling the bearings up with a piece of paper between the bearing and rail.

Now remove the counterweight retaining screw at the front of the stand between the rails. Do not attempt to turn the stand or move the carriage until this is done.

ASSEMBLY OF THE TUBE ARM - The carriage is shipped in its topmost position on the mast. Do not attempt to lock the vertical carriage in a lower position with the vertical travel lock No. 4, Fig. A. It was not designed to hold the entire counterweight. The carriage may be held down by a 2 x 4 tied securely between it and the top casting, but the safest method is to assemble the arm into the vertical carriage in its highest position.

Remove the screw No. 5, Fig. B, from the under side of the vertical carriage. Now insert the pivot post of the horizontal arm into the vertical tube carriage and at the same time put the rotation locking clamp No. 6, Fig. B, over the machined shoulder on the carriage casting, so that the rotation locking knob No. 7 will be against the shorter side of the locking clamp. The screw No. 5 should now be put back into the carriage casting so that it will engage with the groove in the pivot post of the horizontal arm.

CABLE SUPPORTS - The cable support bracket No. 8. Figs. A & B, can now be mounted on the top of the tubestand as shown. The two flathead screws used to hold the tubestand cap on to the mast should be removed and the cable support bracket mounted in these same holes with the 10 32 x 3 inches long, round head screws furnished. These screws are in a mailing bag tied to the cable bracket. Care must be exercised to mount this bracket with the lower end of the cable clamps No. 46, Fig. A, towards the front of the tubestand as shown in Fig. A.

ATTACHING SHOCKPROOF TUBE HEAD - With the horizontal arm in the position shown in Fig. A, the x-ray tube No. 9 should now be mounted on the tilt table No. 10. Naturally different tubes require different mountings. Some tubes have a flat mounting plate as an integral part of the tube. This is provided with holes that fit over the two pins which are a part of the rotation plate on the tilt table. The tube is held securely by the two screws No. 11.

Other tubes are fitted with a small cone or tapered mounting plate similar to the one shown on Fig. A. This type is mounted to a flat mounting plate by means of several clamps No. 90. The mounting plate which is held to the tilt table of the arm by screws, No. 11, should be removed. Then the clamps No 90 should be removed by taking out the flat head countersunk screw from the underside of the plate. The tube can then be clamped securely to the mounting plate with these clamps and the tube and mounting plate attached to the tilt table of the horizontal arm.

The shockproof cables from the tube should pass over the large rollers No. 12 at the top of the tubestand, then should hang down to form a loop before passing up through the cable clamps, at each side of the tubestand. They should then pass

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down from the cable clamps inside the large loops, behind the upper rail of the rail mount before being plugged into the proper terminations of the high tension transformer. In order to pass the cables over the pulleys, it will be necessary to remove the pulleys No. 12, Fig. A, by unscrewing the cap nuts No. 13 and slipping the pulley from its mounting stud. When replacing the pulleys with the cables on them, be sure to tighten the cap nuts securely.

Examine springs in cable terminations to see if they have been damaged during handling or shipment. They should be concentric and should not touch one another. The outer, or larger spring, connects to the small focus filament of the x-ray tube. The inner, or smallest spring, connects to the large focus filament of the x-ray tube. The center or middle spring is common to both.

HIGH TENSION TRANSFORMER - The transformer No. 14 should be placed between the table and the rail mount as shown in Fig. C. The shockproof cable insulators in the transformer are tagged showing which insulators are for the tube under the table, and which insulators are for the tube over the table. The low tension cables are fed from the control up underneath the table and into the transformer shown in Fig. D.

Care should be exercised before putting the high tension cables into the insulators, making sure that all surfaces of the spring contracts are absolutely clean. The inside of the insulators should be inspected and if they are not absolutely clean, they should be thoroughly wiped out. Before turning on any high tension it would be wise to operate the switch on the transformer with the x-ray filaments on to make sure that the proper tubes light at the proper time.

When the transformer is placed in the position shown in Fig. E between the rail mount and the table, with the rail in the same relative position as shown with respect to the table, it will be necessary to have the fluoroscopic carriage pulled towards the front of the table, or at the head end of the table to prevent this carriage striking the transformer when the table is being raised from the horizontal to the vertical.

If the transformer and rail mount are placed in any other position, it will be necessary to check the relative position of all parts at various positions of the table to make sure none of the assemblies interfere with adjacent assemblies.

MOVING TABLE THROUGH NARROW DOORS - If the door way is under 33", it will be necessary to remove the base assembly from the table body.

It will be necessary to remove the table top, the bucky contact guard, and the side finishing strips of the table. It will also be necessary to remove the horizontal carriage from the table, if the doorway is under 32". This can be done by removing the two bearing brackets holding the carriage on to the cross rails. Only the two bearing brackets carrying three bearings each at the head end of the table need be removed. These are held on by two hex. head bolts. The carriage can then be removed from the table.

A heavy bar or pipe should be slipped through the table at each end between the table body and the heavy square rails supporting the top. Then the ends of these bars or pipes should be supported on chairs or boxes of suitable height. If one end is supported slightly higher than the other, the table can be cranked up with the hand wheel 1/2" or so, which will then take the entire weight from the table body off its base assembly. The two large pivot pins can then be removed by first removing the double lock nut on each pin. The pins will then slide out.

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The table can then be guided out of its base and after the bars or pipes have been removed can be carried through the door way, and the base carried in and then the table should be reassembled. Care will have to be taken that the carriage bearings and bearing brackets are carefully reassembled so that the carriage moves freely and that the bearings are neither too loose nor too tight.

It is assumed, of course, that all this work will be done with the table as it comes from the factory. In other words, the heavy counterweight at the foot end of the table will be out and the screen assembly will be off.

ASSEMBLY OF THE TABLE - Remove the table top No. 15, Fig. A, by means of the button head screws around its outer edge. Then bring the table to the vertical position. The large counterweight No. 16, Fig. C, which is packed separately, must be attached to the foot end of the table with the flat side up. After removing the three bolts and washers No. 17, Fig. C, in the table proper, bring the weight over the table with the flat side up and the thicker section of the counterweight towards the inner side of the tilt table. Then with a pinch bar or any heavy steel bar inserted in one of the rear holes, pry up on the counterweight until the back end rests on the tilt table proper. Then force the weight back into the table, making sure that the ledge on the under side of the weight does not fall over the built up section of the table too hard. Some additional prying may be necessary to line up the holes in the weight with the tapped holes in the table body. Put in the screws and pull up tightly to lock the weight securely in place.

ASSEMBLY OF SCREEN ARM - Before replacing the table top, it will be necessary to assemble the screen arm, screen, and diaphragm adjusting cables. The screen arm counterbalance assembly is packed separately together with the diaphragm adjusting cables. Remove the cover plate No. 18, Fig. B from the under side of the horizontal carriage, No. 19, Fig. B. Then put the screen support or counterbalance arm on to the carriage by inserting its three studs No. 20, Fig. B, through the holes in the carriage casting. BEFORE THE SCREEN SUPPORT IS PUT ALL THE WAY INTO THE CARRIAGE, IT IS VERY IMPORTANT THAT THE PLUNGERS NO. 21, FIG. B, FOR THE OPERATION OF THE DIAPHRAGM SHUTTERS IN THE HORIZONTAL CARRIAGE MUST BE PUSHED ALL THE WAY IN. THIS CAN BE DONE FROM THE UNDER SIDE OF THE HORIZONTAL CARRIAGE. THE DIAPHRAGM LEVERS SHOULD BE SO HELD THAT THE FINGERS NO. 22, FIG. B, IN THE VERTICAL SCREEN SUPPORT ARE ALL THE WAY OUT. If the above is not carefully done, the diaphragm fingers in the vertical member are apt to be bent and damaged.

When the vertical screen support is in its final position, tighten the nuts No. 20, Fig. B on the studs. This must be done very carefully to prevent stripping the studs from the vertical member. Then replace the cover plate No. 18, Fig. B.

ATTACHING THE SCREEN - Loosen the retaining screw No. 23, Fig. A, on the screen hanger No. 24 until the pivot hole is clear. Note that the casting to which the hanger fits has a groove machined around its diameter and in the bottom of the groove are two fillister head screws. The above mentioned retaining screw fits down in this groove holding the hanger in place, and the two small screws in the groove act as stops to limit the rotation of the screen. Be sure that the screen hanger has been forced all the way down on the pivot casting and that the screen No. 52 is in the correct operating plane before tightening up the retaining screw.

INSTALLATION OF DIAPHRAGM CONTROL CABLES - The diaphragm control cables No. 25, Fig. A, are shipped attached to the vertical screen support. Care during the assembly must be taken that the control wires do not mar the finish of any associated parts.

MOTOR DRIVE AND HAND TILT MODELS

Remove the three screws No. 26, Fig. D, in the shutter control lever housing No. 27 and screw the housing to the screen fork. The control cable clips No. 28, Fig. D, are fastened to the cable in their correct positions. Fasten them one at a time in their respective positions on the screen fork. Remove the nuts which are only used to secure the clips in place during shipment before fastening them in place. The operating levers No. 53, Fig. A & D, should then close and open the shutters No. 70, Fig. C, freely.

COUNTERBALANCE LOCKS - The Bucky and horizontal counterweights are locked in position for shipment by means of the formed locking clamp No. 29, Fig. C. Remove this by removing the four screws No. 30. This locking clamp and screws should be carefully saved as it will be necessary to relock the weights and moving assemblies with this clamp if the table is ever to be reshipped or moved. The carriage and Bucky should now move freely over the entire length of the table both in the vertical and horizontal positions of the table. Then if this has been thoroughly checked, the table top should be replaced.

MOUNTING TUBE IN THE TABLE - Since the table is totally enclosed and shock-proof, it is normally supplied with mounting for a non-shockproof tube either of the single or double focus type. However, provisions have been made for mounting shockproof tube heads of 15 M.A. capacity.

The non-shockproof tube No. 31, Fig. B, is mounted in the insulating cradle attached to the under side of the horizontal carriage. This entire mounting assembly can be removed from the carriage to facilitate mounting the tube by removing the thumb screw from the single stud on the foot end side of the tube carriage of the table. The tube should now be mounted in the insulated tube mounting brackets No. 32, Fig. B, with the anode end of the tube towards the head end of the table. The reel cords should now be fastened in the insulated posts No. 33, Fig. B, by means of the large button head screw in the end of the rod and at the top of the radiator No. 67. Enough slack in these reel cords, between this screw and the x-ray tube should be left so that the connections can be made without straining the tube. See paragraphs 93, 94 and 95 for further information.

It is essential that the tube under the table be centered with the shutters so that the radiation is centered on the fluoroscopic screen. It may be necessary to shift the tube in its saddle, up or down, so that the focal spot of the tube will center properly with the shutters. This can be shifted by removing the large panel from the under side of the head end of the table as shown in Fig. B.

LIGHT TRAPS - Light traps are provided to cover both the anode and cathode stems of the x-ray tube to shut out the light from these sources. These light shields are wrapped around the stems and are held in place by the bakelite collars which screw over the lead glass shields.

Another light shield in the form of a tube is supplied to fit between the port opening in the lead glass shield of the x-ray tube and the aluminum filter. This effectively shuts out the light from this source.

ATTACHING TRANSFORMER AND CONTROL CABLES AND GROUND WIRES - The control to transformer cable should be connected to the transformer and then to the control. The Bucky cable should also be connected to the control stand. The line cable should be connected from the control to a suitable line switch which is properly fused. Care must be taken to be sure the line frequency and voltage corresponds to that stamped on the nameplate of the control and transformer. Otherwise, serious damage to the apparatus may be the result.

If the bucky is to be operated on either "small focus" or "large focus"

MOTOR DRIVE AND HAND TILT MODELS

position of the main switch, connect its contacts to terminals 48 and 39. If it is desired to operate it on the "large focus" only or the small focus only, consult the wiring diagram of the control.

The timer, cable, the push buttons, and foot switches may now be connected to the control. DO NOT OPERATE THE UNIT UNTIL THOROUGHLY FAMILIAR WITH ITS OPERATION AS OUTLINED IN THE INSTRUCTION MANUAL SUPPLIED WITH THE CONTROL. All separate pieces or units should be connected together and thoroughly grounded (preferably to a water pipe). The ground wire should be No. 12 wire equivalent or larger.

TUBESTANDS, LOCKS, SCALES, STEREO SHIFTS, ETC. - The x-ray tube mounted on the arm of the tubestand can be rotated to any angle. The head can be moved along the tube arm by releasing the travel lock No. 36, Fig. B. This allows full travel across the width of the table.

The x-ray tube may be rotated in either direction on an axis parallel to the axis of the tube. Locks No. 34 can be set to give any desired angle of rotation in either direction up to 45° . Intervals of 5° are indicated on the rotation nameplate.

A stereo shift along the axis of the tube arm is provided. This is controlled by the adjustable lock knobs No. 35, Fig. B, with the nameplate No. 37 graduated in inches of shift.

The entire tube arm may be rotated about its axis and is locked in any position by knob No. 7, Fig. B. The design is such that the arm is approximately balanced at any position. An angle rotation plate No. 38 is graduated in degrees to indicate the angle of rotation. Because the arm is so well balanced it is desirable to set the lock knob against the break shoe just tight enough to produce enough friction to prevent the arm from turning when set at any angle. The arm may then be set at the desired position without touching the lock knob.

The tubestand may be rotated through 360° and is locked in any position by the large lock handle No. 39, Fig. A, at the side of the tubestand. It is locked by moving the lock handle toward the rear of the stand when there are no shockproof cables attached to it. When shockproof cables are attached, the tubestand is limited to 90° each side of center or 180° in all. Notches are provided on the tubes and rotation device to automatically center the tube arm at the 90° position.

The vertical travel of the carriage and tube arm is locked by knob No. 4, Fig. A, which locks the movement against the lock rod No. 40.

TO INSTALL BUCKY CONTACT SYSTEM - First remove the table top, then with the bucky at the foot end of the table insert receptacle end of contact cable into the bucky so that the cable goes to the left of the bucky. The cable is then clamped to the bucky with cable clamps No. 65, Fig. B and to the bucky bearing bracket with the clamps provided. Care must be taken that the clamps are fastened against the coilett on the table. The cable is then stretched to the head end of the table and fastened at the 10-32 tapped hole with a flat clamp across the end of the coilett. The bucky should then be moved to the head end of the table to see that as the cable coils it will not touch any of the table or carriage. The cable can now be threaded between the pulleys and the table body and fastened to the table with cable clamps. See that the cable does not touch any part of the moving mechanism. Pass cable through opening inside of table and form the arc necessary for flexation of the high tension cables. Two clips are provided to clip the high tension cable together and to hold the bucky cable in position on the outside and between the high tension

MOTOR DRIVE AND HAND TILT MODELS

cables. Pass cable through clamp casting on inside of rear base casting. Test to see that cables are not unduly strained or flexed and that cables are not pinched between table body and rear base. Replace table top.

VERTICAL SHIFT - The vertical stereo shift No. 41, Fig. A, is arranged for either hand or magnetic tripping. It can very easily be set for any distance from 2" to 8½" by merely pressing the setting knob on the right hand face and turning to the desired setting while the knob is depressed.

To operate the shift, lock the vertical travel with knob No. 4 and pull the tube and tube arm down against the coiled spring in the shift until it locks. After the first of the stereo pairs has been taken, trip the release by either pulling the release cord or by a magnetic trip and push button, and the tube arm will rise smoothly and quickly to its original position.

An air check is provided which may be adjusted to retard or increase the speed with which the moving mechanism comes to rest. This has been carefully adjusted at the factory and should not be touched unless deemed necessary. If x-ray tubes weighing over 40 pounds are used, a stereo shift with a greater spring tension, will be necessary for satisfactory operation. It is supplied when specified on the order.

The tubestand is provided with a scale No. 42, Fig. D, graduated in inches to indicate the distance from the tube focal spot to the film. The indicating arrows on the plate attached to the vertical stereo shift should indicate this correct distance. This of course will vary with the particular type of tube used, and therefore, should be adjusted by the service man on installation of the machine. The lock handle No. 43, Figs. A and D, locks the entire tubestand against horizontal travel along the rail mount. The horizontal shift No. 44, Fig. C, has a fixed shift of 2½ inches. This can be operated either by a trip cord No. 68, Fig. C, or by an electrically operated magnetic trip.

TABLE LOCK, MOVEMENTS, ETC. - The horizontal and vertical movement of the tube carriage in the table is locked by the single lock lever No. 45, Fig. A. This can be adjusted by loosening the lock nut No. 83, Fig. D, and screwing the entire locking tube in or out to tighten or loosen the locking as desired. The carriage has a lateral movement across the table of 8-1/4 inches and a total travel along the table of 45 inches, thereby giving full coverage of the entire table surface.

The Bucky has a total movement along the table of 43 inches. It may be locked in any position by the lock handle No. 47, Fig. A.

It is available with a centering device. Lever No. 48, Fig. A, operates a slide arm No. 87, Fig. D, which engages with the tube stand horizontal travel lock No. 43, Fig. D, so that at the shoe No. 86, it will automatically center the tubestand with the center of the Bucky.

The engaging member No. 86, in the end of this centering bracket is purposely made of wood and is easily detachable or replaced. The reason for this is that if the table is tilted while the Bucky centering device is engaged, it will break the wood block rather than put a severe strain on the centering device.

OTHER TABLE MODELS - Several models of the tilt table are available. The standard model as shown in Fig. A is a hand crank model, which may be tilted from the vertical, down through horizontal to the Trendelenburg position. The table is automatically locked in any position by means of a clutch shown at No. 51 Fig. A.

MOTOR DRIVE AND HAND TILT MODELS

automatically locked in any position by means of a clutch shown at No. 51 Fig. A. The table can be moved in either direction with or without a patient on the table. A motor drive table is also available. This is raised or lowered by moving a lever mounted in the same position as the hand wheel used on the hand drive tilt table. This operates a specially geared motor which moves the table up or down quietly and quickly. The connection board for the motor, Bucky etc. is mounted under the table body on this model. It is more easily accessible if the table is in a vertical position. Before connecting any leads to this panel, make sure the motor voltage and frequency correspond to that of the line to which it is being connected.

The motor drive table is shown in Fig. F. The motor driven table has incorporated within it an automatic horizontal leveling feature such that when the table is tilted from the vertical position to the Trendelenburg position, the table will automatically stop in the horizontal position. This is also true when tilting the table from the Trendelenburg to the vertical. To tilt the table from the Trendelenburg to the vertical position, the switch operating lever (98), Fig. F, must be moved to the right, and when tilting the table to the horizontal the lever (98) must be moved to the left. Adjustable stops such as (91) are provided to stop the table at the Trendelenburg and horizontal positions.

To release the table at the horizontal position it is only necessary to depress the horizontal release lever (99). Since the action of the horizontal stop depends somewhat on friction and the action of a spring it may be much more convenient to tilt the table slightly away from the horizontal position in order to depress the release lever (99).

COMPRESSION BAND - A compression band which slides over the front and rear finishing strips against the table top is arranged with a ratchet lock to maintain the desired compression. A long curved spring in each slide member prevents the unit from sliding down when the table is in the vertical position.

FOOT REST - The adjustable foot rest No. 54, Fig. A, can be placed on the table as shown and is made to hook in between the table and the side rail finishing strip. There is also available a shoulder rest which is attached in the same fashion.

HIGH TENSION TRANSFORMERS - The standard 200 M.A. rectangular transformer should be placed between the table and the rail mount as shown in Fig. C. The shockproof cable insulators in the transformer are tagged showing which insulators are for the tube under the table, and which insulators are for the tube over the table. The low tension cables are fed from the control up underneath the table and into the transformer shown in Fig. D.

Care should be exercised before putting the high tension cables into the insulators, making sure that all surfaces of the spring contacts are absolutely clean. The inside of the insulators should be inspected and if they are not absolutely clean, they should be thoroughly wiped out. Before turning on any high tension it would be wise to operate the switch on the transformer with the x-ray filaments on to make sure that the proper tubes light at the proper time.

When the transformer is placed in the position shown in Fig. E, between the rail mount and the table, with the rail in the same relative position as shown with respect to the table, it will be necessary to have the fluoroscopic carriage pulled towards the front of the table, or at the head end of the table to prevent this carriage striking the transformer when the table is being raised

MOTOR DRIVE AND HAND TILT MODELS

from the horizontal to the vertical.

If the transformer and rail mount are placed in any other position, it will be necessary to check the relative position of all parts at various positions of the table to make sure none of the assemblies interfere with the adjacent assemblies.

When the birail tubestand is used and a 200 Series transformer is used as above it may also be placed between the birail tubestand and the table. However, this does not permit the operator to work on all sides of the table, which is one of the advantages of the birail tubestand design. Therefore, in the majority of installations it is recommended that the transformer either be placed on the floor behind the center of the floor rail or on a shelf on the wall directly in back of the tubestand.

If the transformer is of the larger type than the Series 200 and is not a 22" diameter round tank or a larger rectangular tank, it will be necessary to place the transformer behind the rail. In this case it will be necessary to carry the high tension shockproof cables, which feed the x-ray tube under the table, under the rail mount. In some instances it may be necessary to place the transformer at or near the head end of the table. If this is done, then the high tension shockproof cables feeding the tube under the table can be carried along the floor around the end of the floor rail.

REPLACEMENT OF TUBESTAND COUNTERWEIGHT - In order to replace a counterweight in the tubestand, it will be necessary to remove the stand from the rail mount by removing the two bearings No. 1 and No. 2 Fig. C. The cable bracket No. 8 Fig. A, together with the top cap casting No. 73, should also be removed. The mast enclosure No. 74 Fig. A, must also be removed.

Remove the lock lever No. 39 Fig. A and the lock lever guide. Then place the tubestand on a pair of boxes or on two chairs, and disconnect the chain from the vertical carriage and push the weight out through the bottom of the mast. Pull the new weight and chain into the mast from the bottom by attaching a wire to the upper end of the chain. Place the chain in the groove of the pulley, and then connect it to the vertical carriage.

Before attempting to put the mast assembly on the rails, be sure that the chain is tight by pushing the weight down as far as it will go. Then replace the mast on the rails, and replace the mast enclosure, tubestand cap, cable bracket, lock lever, and horizontal arm. Tubes weighing in excess of 40 pounds will require a vertical shaft with greater than normal spring tension.

TABLE ADJUSTMENTS - If for any reason the rack and the spur gear drive do not mesh properly the adjustment can be made as follows. **DO NOT MAKE THIS ADJUSTMENT UNLESS NECESSARY.**

HAND DRIVE MODELS - Place table in horizontal position with a box or chair, using rags to protect the finish of the table under the head end. This must be done to prevent the table from falling and to remove the load from the spur gear on the drive shaft. Now remove the plug No. 49, Fig. A, from the center of the hand wheel. This can be done with a rag protected screw driver. Remove the four mounting screws and remove the hand wheel and crank No. 50, Fig. A. At the top of the clutch housing will be found an adjusting screw for the adjustment of slack in the chain. Loosen this screw, but do not remove it. Also loosen the three screws found holding the clutch housing to the leg casting. Now remove the caps which terminate the drive shaft at the outside of the front and rear leg castings with a screw driver, pro-

MOTOR DRIVE AND HAND TILT MODELS

tecting the finish with rags. The bearings for the drive shaft are eccentric, and on the inside, facing the head of the table, will be found an Allen head set screw at either bearings. Loosen these screws and by inserting a wide screw driver in the bearing slots (outside of the table), turn these bushings until the spur gear and rack are in mesh. Be sure that the eccentrics are not turned so far that the spur gear and rack binds. There should be just a little play between the spur and rack. When the proper adjustment is secured **BE SURE TO TIGHTEN THE ALLEN HEAD SET SCREWS WHICH LOCK THE POSITION OF THE ECCENTRIC BEARINGS. IF THESE SCREWS ARE NOT TIGHT, THE TABLE IS APT TO GO OUT OF MESH WITH THE SPUR AND FALL.** Replace the finishing caps in the leg castings. Now fasten the crank temporarily to the clutch face and begin taking up on the chain adjusting screw. Move the crank handle in a small arc not large enough to lift the table until the chain has just a small amount of slack. Tighten the three clutch housing mounting screws and try for chain adjustment by tilting the table to the 45° position and back again to the box or chair. When the table reaches the box or chair, the amount of back lash in the crank will be apparent. If the back lash is more or less than approximately 15°, then the chain must be adjusted accordingly. When the adjustment is complete, remove the crank handle, tighten all the screws, replace the crank handle with the hand wheel, and the play button.

MOTOR DRIVE MODEL - To adjust the mesh of the spur gear and the rack remove the cover (97), Fig. F, and tilt the table to the horizontal position with the head end of the table resting on a box or a chair protecting the finish with rags. This should be done to prevent accidentally completely disengaging the spur gear and the rack and permitting the table to fall. Loosen the four motor base mounting bolts (92) and the jack lock nuts (93). If the mesh is insufficient then back out the jack screws (94) and bear down on the base extension members at the jack screws until the gears mesh properly. Screw the jack screws down until they bear against the base of the table leg and lock by means of their lock nuts (93). If the mesh is too great the reverse is true and the extension of the mounting base must be raised at the jack screws.

BE SURE THAT THE MOTOR BASE MOUNTING BOLTS (92) ARE SECURELY TIGHTENED - If the table stops short of the horizontal position when tilting from the vertical position, then loosen the two screws (95), Fig. F, and shift the fitting (96) from 1/4 to 1/2 inch higher at the head end than at the foot end. This provides for a margin of coast with the patient when tilting the table from the Trendelenburg or the vertical to the horizontal.

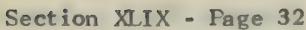
Fig. D shows the screen counterbalance housing with the stepless compression lock. In order to operate the lock depress the lever No. 80, Fig. D, as shown. This places the locking pawls in the "lock position" and prevents the screen from being raised. To release the lock lift the lever No. 80, Fig. D, as far as it will go, thereby releasing the pawls and freeing the screen for movement to and from the table top. In order to release the compression lock under a high degree of compression it may require a slight downward movement of the screen toward the table top.

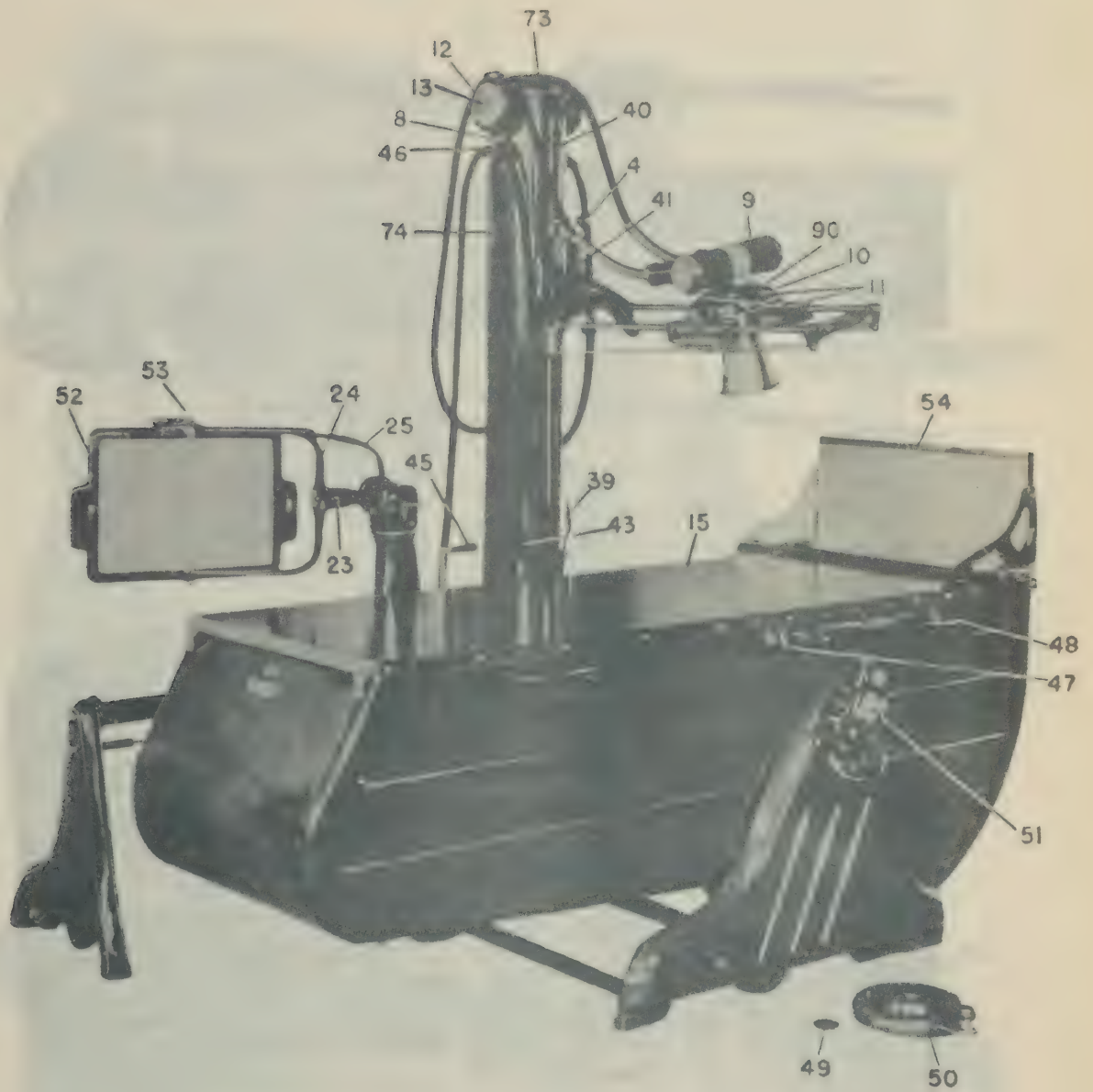
If the screen is unbalanced then remove the 1/4-20 fillister head machine screw at (75), Fig. D. Remove the two hexagon nuts (76), Fig. B, at the lower termination of the shutter limiting operating rod, being careful that none of these parts are lost or mislaid. Remove the screen counterbalance housing (77) from the support member (78) and at the bottom of the housing will be found a cap nut. Loosen this cap nut and tighten or loosen the nut between the cap nut and the housing until screen is properly balanced. Tighten the cap nut against the adjusting nut securely.

MOTOR DRIVE AND HAND TILT MODELS

ADJUSTMENTS

SCREEN PIVOT LOCK - If the screen pivot lock (79), Fig. D, fails to engage automatically and positively in both positions over the table and away from the table, then remove the set screws found at (81), Fig. D. Keep the screen over the table and adjust the set screw found under the one removed, until the lock (79) engages properly and positively. Swing the screen to the rear of the table and adjust the screw at (81), Fig. D, as outlined. Replace the set screws and tighten firmly. If the screen is not parallel with the head end of the table, loosen the three nuts (20), Fig. B, and swing the screen in the proper position. Tighten these nuts securely.





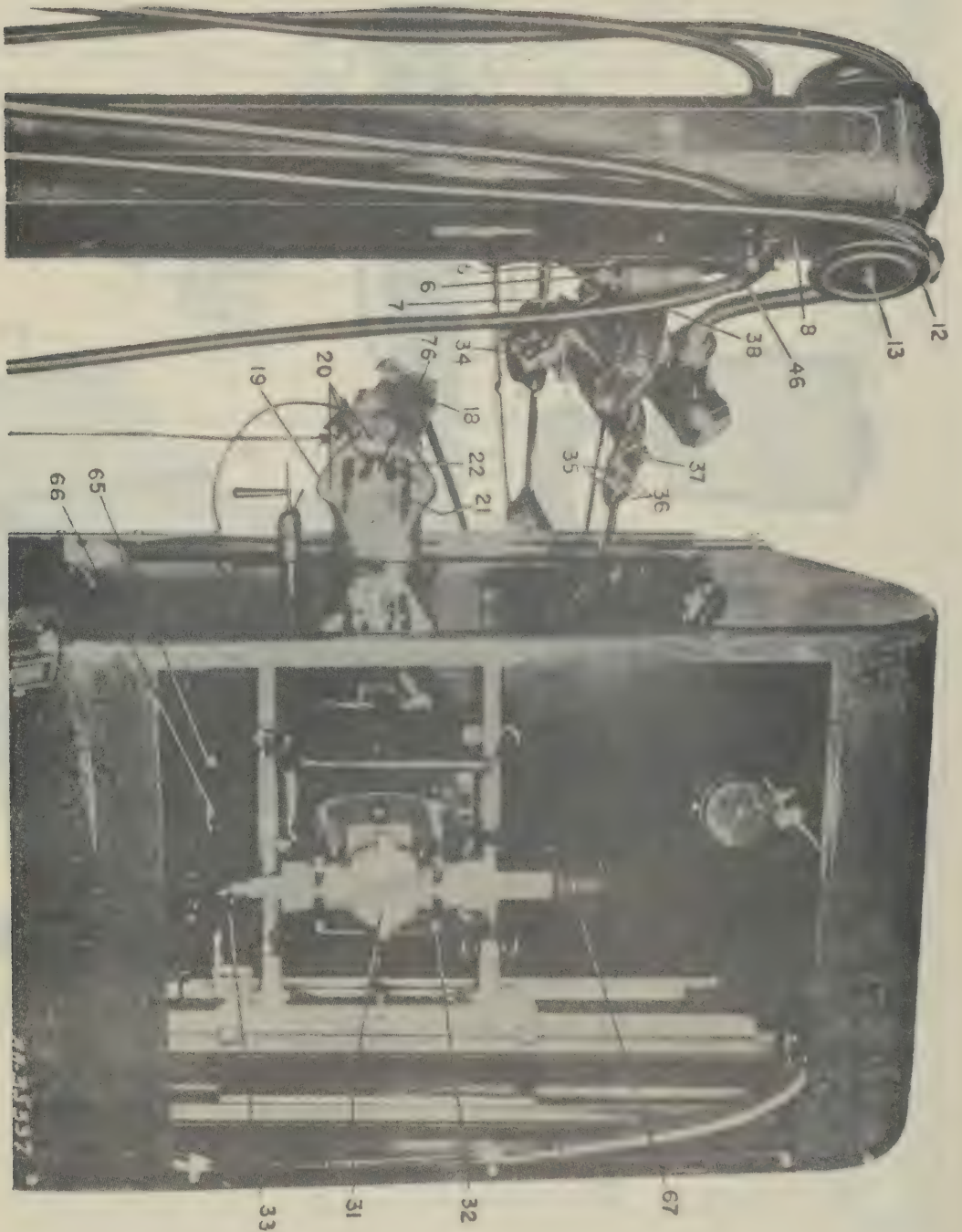


FIG. B

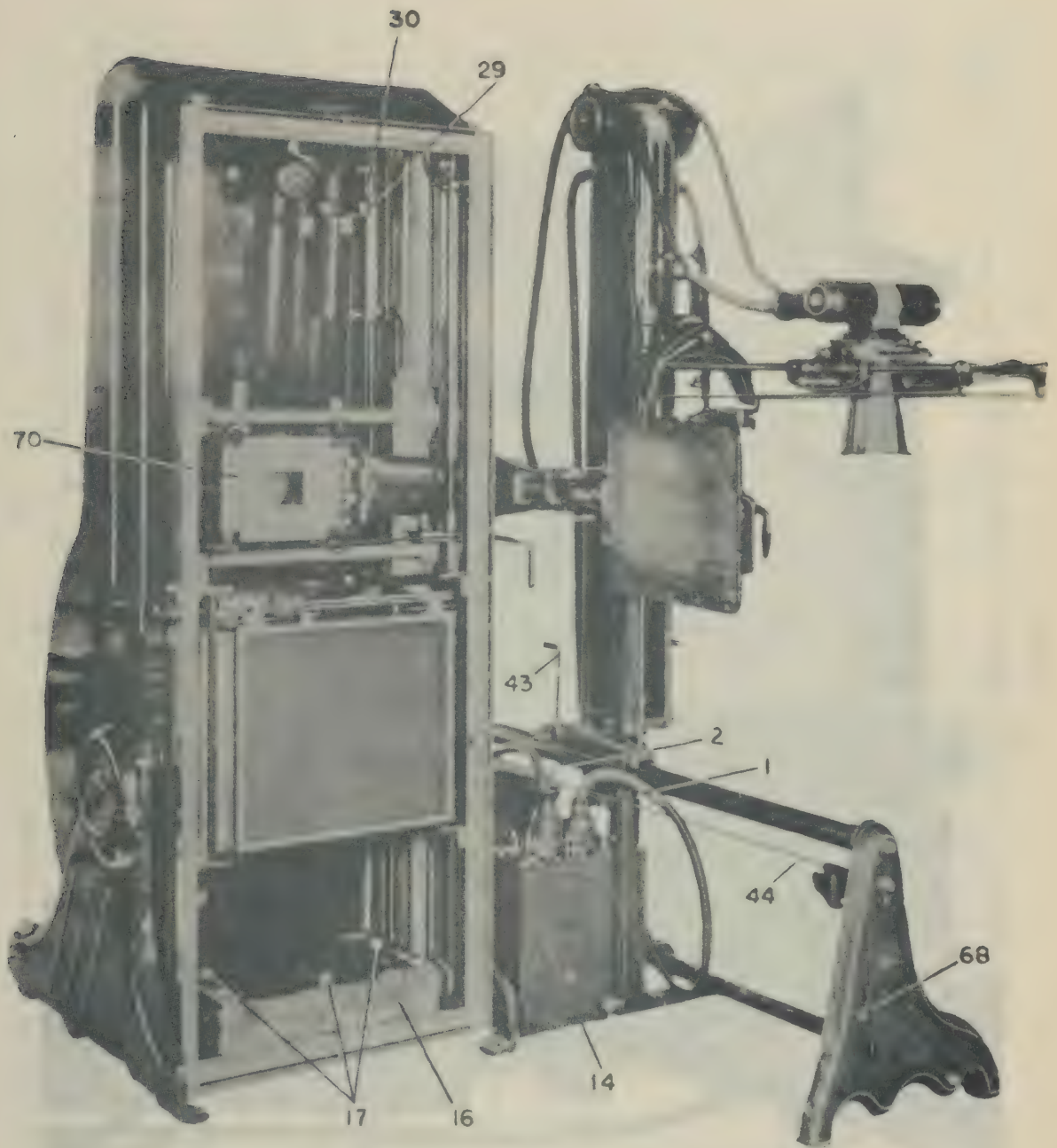


FIG. C

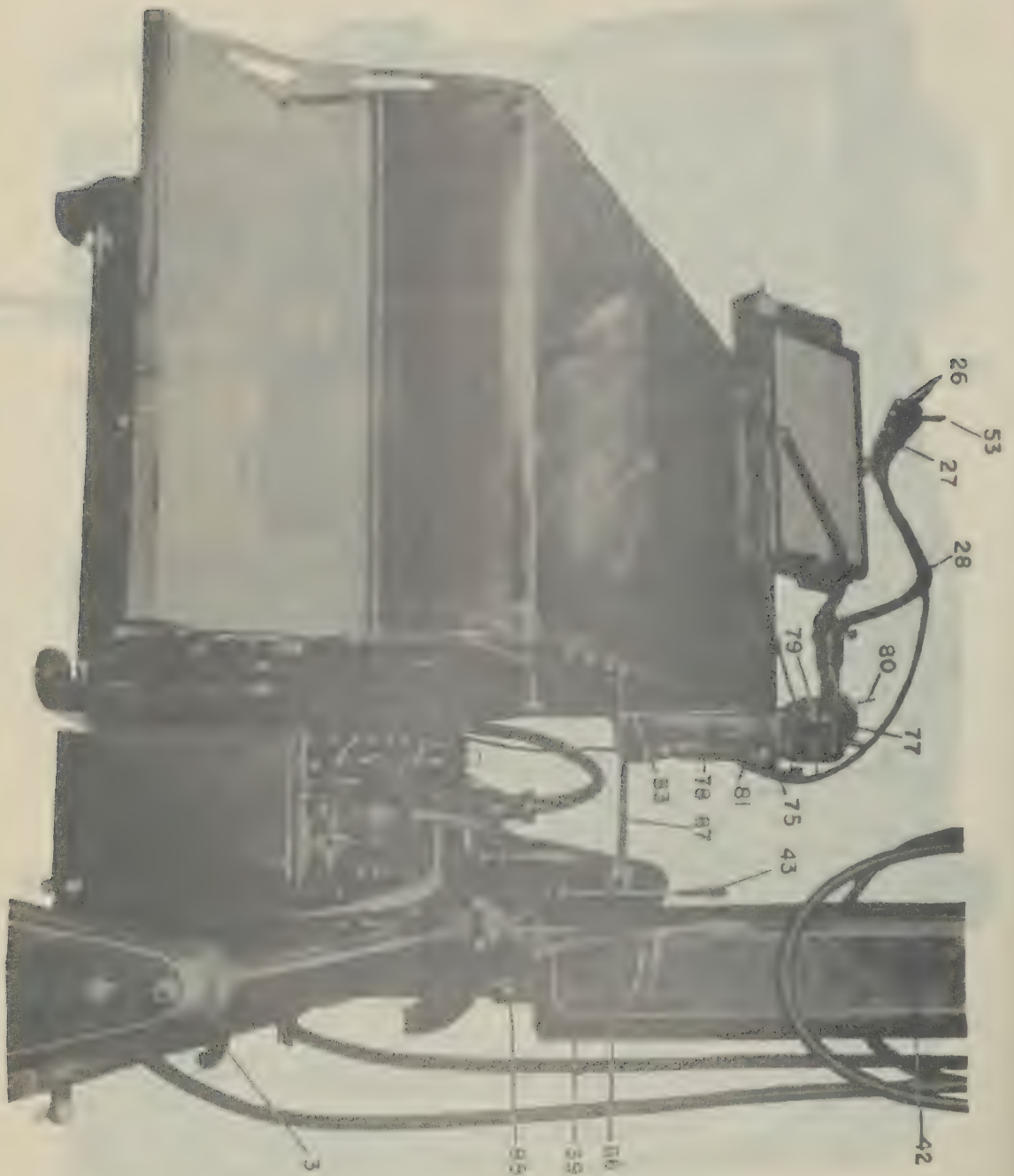
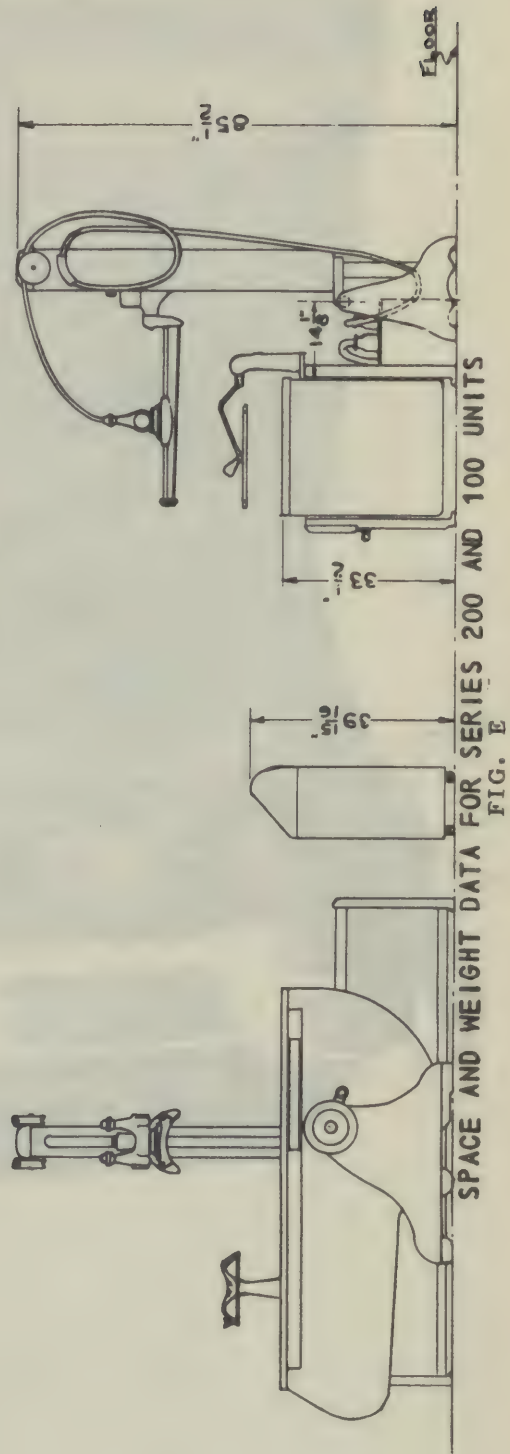
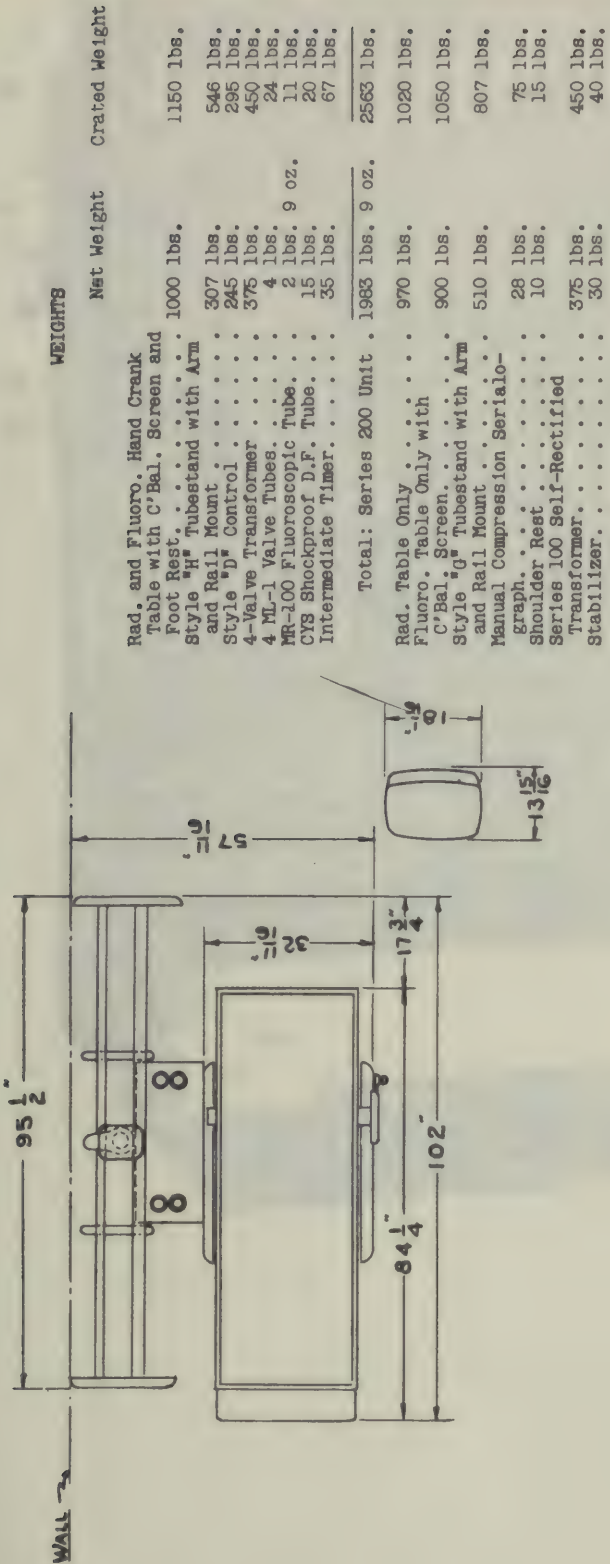


FIG. D

MOTOR DRIVE AND HAND TILT MODELS



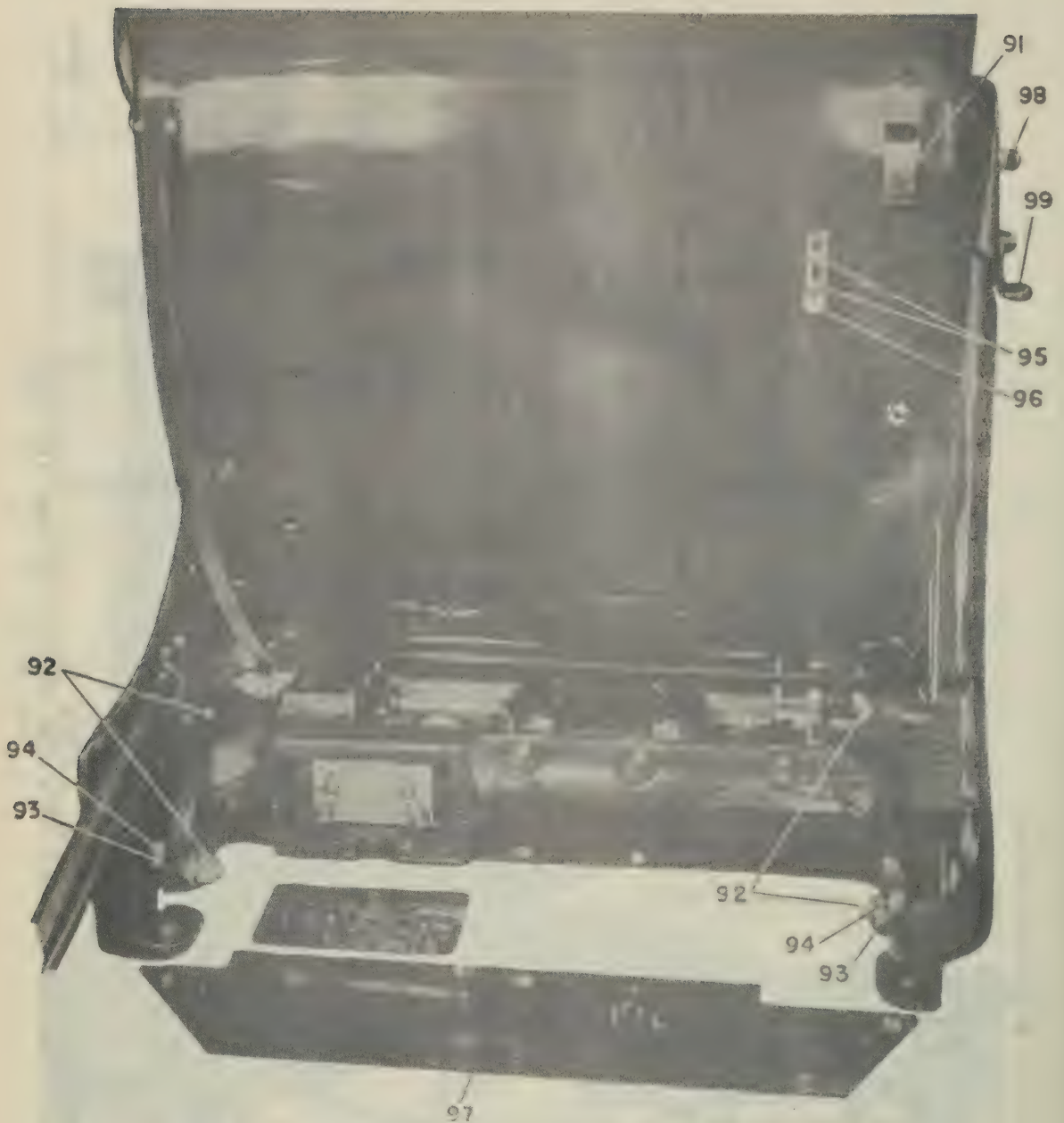


FIG. F

SECTION L

**SPECIAL HAND CRANK,
TABLE AND TUBE STAND - W**

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

GENERAL

Unpacking #16 Table

The following components comprise a complete shipment of the #16 Hand Crank Table.

- 1 - Rayproof Tube
- 2 - Cardboard Containers
- 1 - Fluoroscopic Tower
- 1 - Table Tub
- 1 - Undercarriage
- 5 - Large Counterweights
- 3 - Flat Counterweights
- 1 - Table Top
- 1 - Combination Shoulder - Foot Rest

Carefully unpack the following packages, making certain that no table components are discarded with the wrapping material.

The following components are packed within the two cardboard containers.

- 1 - Shutter Assembly
- 1 - Compression Device
- 1 - Cathode Socket
- 1 - Collar
- 1 - Jones Plug
- 4 - Cable Collars
- 4 - Levelling Plates
- 1 - Fluoroscopic Tower Lock
- 3 - Caution Bags (Hardware)
- 1 - Bucky Release Cord
- 2 - Porcelain Insulators

The Undercarriage is packed in a separate container along with eight Counterweights.

- 5 - Heavy Rectangular Counterweights.
- 3 - Light Flat Counterweights.

The table top container has included.

- 1 - Table Top
- 4 - Angle Strips
- 2 - Chrome plated compression device rails

Unpacking #6 Tubestand

The following components comprise a complete shipment of the #6 Tubestand.

- 6 - Small Circular Counterweights
- 1 - Carriage Casting
- 1 - Lower Bearing
- 1 - Tube arm
- 1 - Filter
- 1 - Tube Adaptor
- 1 - Rail With Scale
- 1 - Rail Without Scale
- 2 - End Legs
- 2 - Center Legs
- 2 - Rubber Bumpers
- 1 - Caution Bag (Hardware)
- 1 - Tubestand
- 5 - Cable Clamps

Carefully unpack the various packages in which the tubestand is shipped making certain that no tubestand components are discarded with the wrapping material.

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

DESCRIPTION OF TABLE (REFER TO FIGURE C-5657)

1. **TUBE** - The #16 table tub is shown as item 1 in figure C-5657. The following components are mounted within the tub: bucky, bucky counterweight, fluoroscopic tower, rayproof tube, shutter assembly, main table counterweights, high tension reels and fluoroscopic tower counterweight.

2. **ANGLE STRIPS** - The angle strips for securing the table top to the table are shown as item 2 in figure C-5657. In reality there exist two types of angle strips; two short strips and two long strips. The long strips are provided with extra holes along their sides to facilitate attachment of the compression device rails, item 3, to the sides of the table.

3. **COMPRESSION DEVICE RAILS** - The compression device rails are shown as item 3 in figure C-5657. Their purpose is to provide a means of attaching the compression device to the table top. The spacers, item 4, which are used in securing the compression device rails to the sides of the table also serve as a means of attaching the removable foot rest to the table when the table is in vertical use. There are fourteen positions in which the removable foot rest may be secured.

4. **COMPRESSION DEVICE RAIL SPACERS** - The compression device rail spacers are shown as item 4 in figure C-5657. Each rail requires fourteen spacers in order to be secured to the sides of the table. As outlined in paragraph three, the spacers also serve as a means of attaching the removable foot rest to the table when it is in a vertical position.

5. **FLUOROSCOPIC SCREEN FORK** - The fluoroscopic screen fork is shown as item 5 in figure C-5657. Within it is mounted the fluoroscopic screen assembly which is held in position by means of rails and spring pins, item 7.

The fork assembly has been accurately counter balanced at the factory so that it may be moved vertically through its entire travel and remain in any desired position within this travel without the necessity of locking.

The shutter control knobs, item 13, are also mounted on the screen fork as are the screen rotation locks items 8 and 12.

6. **FLUOROSCOPIC TOWER** - The fluoroscopic tower is shown as item 6 in figure C-5657. It may be moved along the length of the table as well as transversely. A lock handle has been provided to facilitate locking the tower into position; this is shown as item 9. Contained within the fluoroscopic tower are two sets of counterweights for the screen and fork assembly. The tower is secured by means of flexible cable to the main counterweight thereby counterbalancing it for operation in any position.

7. **FLUOROSCOPIC SCREEN LOCK PINS** - The screen lock pins are shown as item 7 in figure C-5657. Their purpose is to lock the screen assembly into position once it has been inserted into the screen tracks. Removal of the screen assembly is accomplished in the following manner. First, pull the spring screen lock pins upward. This action will remove the lock pin from the screen. The pin is then rotated slightly so that the guide pin may not fall back into position. The lock pin is then released. The same procedure is repeated on the other pin. When this is finished the screen assembly may be withdrawn.

CAUTION - It is essential that the screen fork be raised to its uppermost position before removal of the screen is attempted, otherwise the screen fork, becoming unbalanced due to the removal of the screen will jump to its uppermost position thereby causing damage to the fork mechanism.

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

8. SCREEN AND FORK ROTATION LOCK - The screen and fork rotation lock is shown as item 8 in figure C-5657. In normal operation the screen and fork assembly may be moved in a direction parallel to the table top. Special types of techniques may require the screen and fork assembly to be temporarily moved away from the table top in order to gain greater accessibility to table bucky. For such techniques the screen and fork assembly may be temporarily moved aside in the following manner. First, the screen and fork safety lock is depressed, item 12. This is located directly behind the shutter control knob, item 13. With the safety lock depressed the screen and fork rotation lock handle, item 8, is pushed back. The screen and fork arm may now be pivoted so that it moves parallel to the table top about a point located on the fork mounting in the fluoroscopic tower. When the fluoroscopic screen has been swung about 15° in this direction the screen rotation lock, located in front of the fork rotation lock, item 8, is turned in a clockwise direction and held there. The fluoroscopic screen and fork may now be swung downward, i.e. clockwise direction, until it is parallel with the fluoroscopic tower assembly. With the screen in this position the entire fork unit may be moved to the left, when viewing the table as shown in figure C-5657.

To return the fluoroscopic screen back into its original position press the screen and fork rotation lock, item 8, to the right, this will release the screen and fork unit. Proceed to swing the screen until it is parallel to the fluoroscopic tower. At this point the screen and fork rotation lock will fall into its normal position. The screen rotation lock, located directly to the left of item 8 is now turned clockwise and held in position while the screen is swung about until it is parallel to the table top.

CAUTION - The safety lock must always be operated before the screen and fork rotation lock handle is pushed backward. It is recommended if maximum accessibility to the table is required that the screen be moved as outlined above, otherwise the tower lock handle, item 9, will interfere with screen rotation.

9. FLUOROSCOPIC TOWER LOCK - The fluoroscopic tower lock handle is shown as item 9 in figure C-5657. Its purpose is to secure the tower into position once it has been set. The lock may be operated by means of the handle shown as item 9, or by a front tower lock lever. This is shown in figure C-5657, lying to the left and a little below the bucky lock handle, item 14. The front and rear locks operate in tandem, one may be used to lock the tower and the other to unlock it. Therefore, it is not necessary to operate the same lock for locking and unlocking purposes. It is recommended that the tower be locked into position when the fluoroscopic screen and fork assembly is manipulated as outlined in Paragraph 8.

10. SHUTTER CONTROL CABLES - The shutter remote control cables are shown as item 10 in figure C-5657. By means of these cables it is possible to have full control over the fluoroscopic tube shutters from the remote fork arm position. The shutter cables actually run in flexible wound steel cables which prevent possible injury to the shutter control cables. The shutter control knobs operate in tandem and by means of connecting rods terminate in one pair of remote control cables.

11. REMOVABLE FLUOROSCOPIC SCREEN - The fluoroscopic screen assembly is shown as item 11 in figure C-5657. The screen frame assembly may be removed from the fork assembly by means of the procedure outlined in paragraph 7.

12. SCREEN AND FORK ROTATION SAFETY LOCK - The screen and fork rotation safety lock is shown as item 12 in figure C-5657. As outlined in Paragraph 8, the safety lock, item 12, must be depressed before the screen and fork rotation lock becomes operable. Item 12 must be always be depressed and held in this position,

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operating item 8 at the same time and swinging the screen to the left. Item 12 must be held until the screen and fork rotation locking pin has been removed from the locking position. At this point item 12 may be released.

NOTE - Never attempt to operate item 8 before depressing the safety lock, item 12.

13. FLUOROSCOPIC SHUTTER CONTROL KNOBS - Two sets of fluoroscopic shutter control knobs have been provided on the arms of the fork assembly. They are shown as item 13, figure C-5657. The fluoroscopic shutter control knobs are so connected that the two upper knobs operate in tandem. Similarly the two lower knobs.

A more detailed picture of the fluoroscopic shutter control assembly may be seen in figure C-5646.

A brief study of this figure will show that item 10 connects the two lower knobs through a lever arm, item 8. Similarly the two upper knobs are connected together by means of item 9 and lever arm, item 7.

The two flexible shutter control cables, item 6, may be seen connected to lever arms, item 7 and item 8.

Item 5 in figure C-5647 is the safety lock control cable which controls the operation of the screen-fork rotation lock, item 4.

14. BUCKY LOCK - Although the bucky has been provided with travel over the entire length of the table, it may be secured in any position, whether the table be in a horizontal or vertical position by means of the bucky lock mechanism, item 14 in figure C-5657. The lock mechanism is of the friction type and is operable when the bucky lock lever arm is turned in a clockwise direction. The lock may be released by turning the lever arm in a counterclockwise direction.

15. BUCKY TIMING CONTROL - For bucky work it is desirable to have an adjustable speed bucky which should always set in accordance with the particular type of technique used. It is always recommended that the bucky speed, as indicated by the timing control knob, be set for a time interval slightly longer than the exposure timer setting. This procedure always insures a bucky in motion while the exposure is being taken. The timing knob is provided with the following marked time intervals, as indicated by item 15, figure C-5657, 1/10, 1/6, 1/4, 2/5, 3/4, 1, 2, 3, 4, 6, 8, 10, 20 and 30 seconds.

The bucky time control selector should always be set prior to a bucky exposure. The bucky is "cocked" by means of the "setting" knob, item 16, figure C-5657 and may be released either manually (i.e. pulling item 21), or electrically by means of the bucky magnet release coil.

A brief outline of the electrical release will be given below. The bucky is normally provided with a magnetic release coil whose circuit is completed through a set of normally closed contacts contained within the bucky itself. These contacts are normally open unless the bucky is "cocked". Two other contacts are provided within the bucky for controlling x-ray exposures; these contacts are normally open unless the bucky is in motion. The two bucky magnet release wires and the exposure timing contact wires are brought out to the side of the table as the following leads, BM, BMC, and BC. Note that although we have two wires for the bucky release magnet and two wires for the timing contacts, the termination is made to a three wire circuit; terminal BMC being common to both the bucky magnet and the timing contact.

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The bucky timing contacts are normally wired in series with the timing contacts of the exposure timer. The electrical circuits are so arranged that operation of the second trigger of the trigger switch applies potential to the BM, BMC terminals, which release the bucky. Once the bucky is released the BM circuit is opened. After the bucky has reached a pre-determined speed the BMC and BC contacts close. With BMC and BC closed the exposure is initiated. The exposure should always be terminated by means of the exposure timer and not the bucky timing contacts.

16. BUCKY "RE-SET" KNOB - As the bucky is not set automatically after the termination of a given exposure, it is necessary to reset it by means of the reset knob, shown as item 16 figure C-5657. To reset the bucky, pull item 16 outward as far as it will go, then release it. Termination of a bucky exposure is always followed by a single stroke of a caution bell built within the bucky. The bell always sounds at the end of a bucky exposure, indicating that the bucky must be reset.

17. BUCKY POINTER - To facilitate alignment of the bucky with the tubestand, a pointer, item 17, figure C-5657 has been provided. The pointer indicates on a scale built into the table. The table scale corresponds with the horizontal scale on the tubestand top rail. The scale built into the table reads from 1 to 54 inches. The scale on the tubestand is similarly marked. When the table is in a horizontal position and the left index of the tubestand carriage (as when viewed from the front table side) set to 30 inches with the tube arm locked into its proper position, i.e. tube arm at 90 degrees with respect to the rail mount, the bucky index pointer must then be set to 30 inches if the bucky is to be used for a radiographic exposure.

It is essential that before the tubestand be secured to the floor, that careful alignment be maintained between the table and tubestand.

18. ANGULATION SCALE - The angulation scale is shown as item 19 in figure C-5657. The scale has been provided to enable parallelism to be maintained between the table top and tube when the table is operated in positions other than horizontal.

An angulation scale has also been provided on the tubestand to facilitate this adjustment.

19. ANGULATION POINTER - For table operation in positions other than horizontal the angulation above or below a horizontal plane may easily be determined by reading the position of the angulation pointer with reference to the angulation scale. The angulation pointer is shown as item 20 in figure C-5657.

20. BUCKY RELEASE CORD - As outlined in paragraph 15 the bucky may be released either electrically or mechanically. The electrical release was fully discussed in Paragraph 15.

For applications where no auxiliary electrical release is provided the bucky may be released manually by pulling the bucky release cord, shown as item 21 in figure C-5657.

All operating precautions outlined in Paragraph 17 should be strictly adhered to.

21. HAND CRANK KNOB - The hand crank knob is shown as item 22 in figure C-5657. By means of a special automatic spring clutch mechanism housed within the crank drum the table may be placed in any position and left there without the necessity of other auxiliary brakes.

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CAUTION - Do not tamper with any of the automatic clutch adjustments within the crank drum.

22. BEARING BLOCK - The entire table is suspended on a set of bearing blocks shown as item 23 in figure C-5657.

It is recommended that these bearing blocks be checked from time to time to see if they are sufficiently greased. (See Paragraph on "Service Notes".)

CAUTION - Never attempt to remove the bearing blocks when the table is in a vertical position.

23. FLUOROSCOPIC TOWER COUNTERWEIGHT CABLE - The fluoroscopic tower counterweight cable is shown as item 1 in figure C-5654. The cable has been installed at the factory and should need no further adjustments. If adjustments are necessary see Paragraph on "Service Notes". The cable is normally run over two pulleys located at the head and foot ends of the table and terminates in the fluoroscopic carriage on one end and in the fluoroscopic tower counterweight at the other end. The other half of the fluoroscopic tower counterweight is run in a similar manner.

CAUTION - Adjustments of the counterweight cable should never be attempted with the table in a vertical position. (See Paragraph on "Service Notes".)

24. FLUOROSCOPIC TUBE RETAINING PANEL - The fluoroscopic rayproof tube, item 4 is normally mounted within two split clamps rigidly secured to the tube adapting panel, item 7, figure C-5654. The tube adapting panel is in turn secured to the fluoroscopic tube retaining panel, item 2, figure C-5654, by means of two wing bolts. The holes through which the wing bolts pass have been slotted to enable adjustment of rayproof tube.

The retaining panel item 2, figure C-5654, is part of the fluoroscopic shutter assembly.

25. RAYPROOF TUBE - The rayproof tube assembly is shown as item 4 in figure C-5654. It consists essentially of a tube, 2 split clamps, an anode reel (item 8, figure C-5654) a cathode porcelain supporting insulator (item 5, figure C-5654) and a cathode connector plug. The entire rayproof tube assembly is adjustable in order to enable centering of the x-ray beam on the fluoroscopic screen.

26. CATHODE PORCELAIN SUPPORTING INSULATOR - As the cathode connector is of the plug-in type, support must be made of the cathode connector wires carried from the cathode reels, item 13, figure C-5654, to the cathode socket. The cathode wires are secured to the supporting insulator thereby eliminating all strain from the cathode connector. The cathode supporting insulator is made of porcelain and is shown as item 5 in figure C-5654.

27. CATHODE CONNECTOR - A double focus type of x-ray tube has been provided under the table. The cathode end terminates in three prongs, common, small and large. To facilitate connecting the tube to the cathode high tension cable, reels have been provided, they are shown as item 13, figure C-5654. The three cathode high tension reels terminate in a plug-in type of cathode connector which is polarized to prevent improper insertion into the tube.

As the connector is of the plug-in type, strain relief is provided to prevent the connector from being withdrawn by virtue of the spring tension in the three cathode reels.

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28. ADAPTOR PLATE RETAINING WING BOLTS - The entire rayproof tube assembly, item 4, figure C-5654 is held securely to rayproof tube retaining panel, item 2, figure C-5654 by means of two adaptor plate retaining wing bolts. The rayproof tube assembly may be removed intact by removing the anode reel connection to anode cable, disconnecting the cathode porcelain supporting insulator and removing the cathode plug. It is recommended that once the rayproof tube has been properly aligned in relationship to the fluoroscopic screen that the wing bolts be securely tightened to prevent shift of the tube due to drag by the cable reels.

29. ANODE REEL - The anode reel is permanently secured to the fluoroscopic rayproof tube assembly and is shown as item 8, figure C-5654. The free end of the anode reel connects to the anode high tension cable in the upper section of the table as viewed in figure C-5654.

A more detailed view of the anode high tension reel is shown in figure C-5649. In this view the reel is shown as item 12. Note that the reel is secured to the narrow micarta strip which in turn is fastened to the lower end of the tube split clamps. A lug, item 10, figure C-5649 has been provided to enable attachment of the anode reel to the anode inlet cable.

30. BUCKY INLET CABLE - The bucky inlet cable is shown as item 10 in figure C-5654. The cable is plugged into the bucky and serves as a flexible means of bringing out the BM, BMC, and BC terminals to the Jones male connector affixed to the side of the table.

The bucky inlet cable runs over a pulley after leaving the bucky, around the bucky counterweight as shown in figure C-5654, and over a special pulley arrangement held taut by a spring mechanism.

In this manner all unnecessary slack is removed from the bucky inlet cable, which normally results when the bucky is moved over the length of the table.

31. CATHODE CABLE - The cathode high tension cable is shown as item 11, figure C-5654. The cable is secured to the table by means of clamps shown as item 17, figure C-5654. Termination of the cathode cable is made in three flexible leads with lugs marked "C", "S" and "L". The "C" stud is the common terminal for both the large and small focal spots. The "S" terminal is the small focal spot inlet, and the "L" terminal is the large focal spot inlet. It is essential that the three marked cathode terminals be properly wired to the three cathode high tension reels to insure proper selection of focal spots.

32. CATHODE HIGH TENSION INSULATOR POSTS - The two micarta posts shown as item 12, figure C-5654 comprise the cathode high tension insulator posts. The posts provide a means of clamping the cathode high tension cable securely within the table. The cathode high tension reels, item 13, figure C-5654 are screwed on to one side of beveled post tops. The other side, not clearly shown in figure C-5654 is provided with a clamp for securing the cathode high tension cable sheath.

It is essential that the reels and cable sheath be rigidly held by the two cathode high tension posts, otherwise, the reels or sheath clamp may work loose due to reel strain. The cathode reels should therefore be inspected periodically.

33. CATHODE HIGH TENSION REELS - To provide a flexible means of connecting the filament of the rayproof tube to the cathode high tension cable three cathode reels, item 13, figure C-5654 have been provided. As outlined in paragraph 32 the cathode high tension cable is secured to one side of the cathode high tension

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insulator posts. The connection to the cathode high tension reels is made by means of an acorn nut and lock washer to a stud protruding through the bottom of the reel mounting strip. With the cathode cable sheath in position and clamped securely by means of the sheath clamp, the three flexible high tension cable leads are passed underneath the three reels and electrically connected. It is most practical to use the following method in connecting the cathode high tension cable to the reels; let the left reel, when viewed as in figure C-5654 be the "L" terminal; the center reel becoming "S" and the extreme right reel being "C".

NOTE - The termination of the cathode high tension cable is made in three marked flexible leads; they are C, S and L.

34. ANODE HIGH TENSION CABLE - The anode high tension cable is shown as item 14 in figure C-5654. The cable is secured to the sides of the table by means of clamps item 17, figure C-5654. Mounted on the top narrow end of the table is a poreclain post. This item is not shown in figure C-5654, but serves as a means of anchoring the high tension anode cable within the table. The flexible lead from the anode reel, item 8, figure C-5654, and anode high tension inlet cable are joined at the poreclain post.

It is recommended that the porcelain post be inspected periodically and cleaned with lint free cloth. This procedure when carefully adhered to enables the high tension system to be trouble-free in its operation.

DESCRIPTION OF TUBESTAND

1. RAIL MOUNT LEG (CENTER RIGHT) - The center right rail mount leg is shown as item 1 in figure C-5655. The upper and lower rails are secured to this leg by means of 3/8 X 16 machine screws. The upper rail is held with a 3/8 X 16 X 1 1/4 inch screw and the lower rail with a 3/8 X 16 X 1 1/2 screws.

2. STEREO LOCK KNOB - The stereo lock knob is shown as item 2 in figure C-5655. It is operated, locking the stereo release mechanism to the stereo rod, item 6 figure C-5655, when the tubestand is to be used only for vertical stereo. When non-stereo operation of the tubestand is desired, the stereo lock knob should be left free.

3. VERTICAL STEREO COUNTERWEIGHTS - Six vertical stereo counterweights have been provided to produce the proper amount of counterweighting for the tube arm when it is to be used for vertical stereo work. The counterweight is shown as item 3 in figure C-5655. Depending on the type of tube, size and length of cone, and rate of stereo shift required, the proper number of weights are added to the counterweight retaining rod, shown as item 4 in figure C-5655. The counterweights provided consist of five large units and one small unit. A central hole has been provided in the counterweights to facilitate quick addition or removal.

4. COUNTERWEIGHT RETAINING ROD - The counterweight retaining rod is shown as item 4 in figure C-5655. Its purpose is to provide a quick and simple means of adding the desired counterweighting to the tube arm when it is used for vertical stereo work. In this manner proper vertical shift may be provided, compensating for variables, such as size and length of cones, and relative weight differences in tubes.

5. TUBESTAND COLUMN - The main portion of tubestand consists of a column shown as item 5 in figure C-5655. The column serves as a means of housing the necessary counterweights used in counterbalancing the tube arm and tube. The main column is

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provided with a vertical scale which enables quick determination of target to table top distance when the table is in a horizontal position. The target to table top distance is read from the top of the vertical carriage to the scale secured on the tubestand.

6. **STEREO ROD** - The stereo rod is shown as item 6 in figure C-5655. It is recommended that the stereo rod be loosely held in position when the tubestand is in operation. In this manner the stereo mechanism may be made to operate smoothly. Normal procedure when the tubestand is to be used for vertical stereo work is to tighten the stereo lock knob, item 2, figure C-5655, set the stereo mechanism for desired stereo shift and push the tube arm upwards until it locks into position. When the tubestand is to be used for non-stereo work, the stereo lock knob should be free.

7. **CABLE ROLLERS** - Cable rollers, item 7, figure C-5655, have been provided to minimize cable drag and enable the tube arm to be used for horizontal stereo work. The rollers marked item 7 in figure C-5655 are for the anode cable. A similar set to the left of item 7 is for the cathode cable.

8. **TUBE ADAPTOR RETAINING SCREWS** - The shock proof tube used on the #6 tubestand is first mounted on an adaptor plate which is in turn secured to the tube arm by means of two knurled thumb nuts shown as item 8 in figure C-5655. The thumb nuts are removed first and the tube adapting plate placed in position. The thumb nuts are then replaced securing the tube adapting panel.

9. **TUBE ANGULATING LOCK** - Item 9, figure C-5655 shows the tube angulating lock handle. A more detailed view of the angulating lock is shown as item 4, figure C-5648. When turned in a clockwise direction, the tube angulating mechanism locks. Conversely, counterclockwise rotation releases the mechanism. The degree of tube tilt is shown by a pointer on the angulating scale, item 5, figure C-5648. It is possible to tilt the tube in either a clockwise or counterclockwise direction when viewing the tube arm as in figure C-5648.

10. **HORIZONTAL STEREO** - As outlined in Paragraph 7, "Cable Rollers", the tube arm may be used for horizontal stereo. The horizontal stereo is set by means of two limit adjustments shown as item 10 in figure C-5655. The maximum horizontal stereo obtainable is 3 inches. To adjust the tube arm for this stereo shift, proceed in the following manner. Set the tube so that the center line reference is opposite zero on the tube arm horizontal scale. Adjust the left limit knob, as viewed in figure C-5655, until it is centered about the tube center reference line.

Now the tube may be moved horizontally one and one half inches on either side of the zero point on the tube arm. The zero reference point on the tube arm corresponds to the center of the table. The maximum horizontal motion of the tube is nine inches, i.e. four and one half inches on each side of the zero reference point. The horizontal stereo adjustable limits also serve as a means of clamping the tube into position on the tube arm. The tube is clamped in the following manner. Set the tube reference line opposite the zero reference point on the tube arm. Move the right adjustable stop, item 10 in figure C-5655 until it touches the tube holder. This will prevent the tube from moving to the right. Adjust the left stop until it also touches the tube holder. This locks the tube and prevents any horizontal shift along the tube arm. It is recommended that the right adjustable stop be loosened and moved to its extreme right position when the tubestand is to be used for horizontal stereo works.

11. **HORIZONTAL CARRIAGE LOCK** - The horizontal carriage lock handle is shown

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as item 11, figure C-5655. By means of this lock, horizontal travel of the tube stand may be set to any desired value. Turning the handle in a direction to the left as shown in figure C-5655 secures the horizontal carriage to the top rail, item 14, figure C-5655. Conversely, turning the handle in a direction to the right as shown in figure C-5655 releases the lock mechanism and permits the tubestand to be moved along the railmount.

12. HORIZONTAL CARRIAGE - The horizontal carriage is shown as item 12 in figure C-5655. A lock is provided on the carriage to control horizontal travel. The purpose of the horizontal carriage is to provide a means of securely holding the tubestand in a rigid vertical position. The carriage is provided with a split clamp through which the vertical tubestand column is passed. The lower end of the vertical tubestand is held by means of the lower bearing, item 16, figure C-5655. To insure ease in operation, the horizontal carriage is provided with four roller bearings which may be seen in figure C-5655. Two index nameplates have been mounted on the top surface of the horizontal carriage. The nameplates are accordingly marked "Horizontal" and "Vertical". The horizontal nameplate is mounted on the left end of the horizontal carriage as shown in figure C-5655. The vertical nameplate is mounted on the right end of the horizontal carriage. When the table is in a horizontal position the left index gives a reading of the distance from the "head end" of the table (narrow-end) to the center of the tube target. The scale on the left end of the top rail corresponds to the bucky scale on the table, i.e. scale reading from 1 to 54 inches. When the table is in a vertical position, the right index gives a reading of distance from the tube target (tube turned so that it is parallel to the table top) to the center of the bucky. The scale on the right end of the top rail, reading from 12 to 30 inches gives target to center of bucky distance when the table is in a vertical position.

13. RUBBER BUMPERS - A rubber bumper, item 13, figure C-5655 is provided at each end of the top rail. Its purpose is to prevent mechanical shock to the tube and tubestand when the horizontal carriage reaches the end of the rail travel.

14. TOP RAIL - The top rail is shown as item 14, figure C-5655. As outlined in Paragraph 11, the top rail is provided with two special scales. The scale on the left when viewing the top rail as in figure C-5655 enables quick determination of alignment between the center of the bucky and the center of the tube. The scale on the right when viewing the top rail as in figure C-5655 enables target to center of bucky distance to be quickly determined when the table is in a vertical position. The two center legs are secured to the top rail by means of $3/8 \times 16 \times 1\frac{1}{4}$ inch bolts. The end legs are secured by means of $\frac{1}{2} \times 13 \times 2$ inch bolts.

15. END LEG - The right end leg is shown as item 15 in figure C-5655. The top and bottom rails are mounted within this leg and secured by means of $\frac{1}{2} \times 13 \times 2$ inch bolts.

16. LOWER BEARING - The lower bearing, item 16, figure C-5655 serves as a means of rigidly holding the tubestand in place. It is provided with two roller bearings to give smooth operation and enables movement of the tubestand with a minimum of effort. The lower bearing has a split clamp into which the tubestand is seated. To facilitate proper operation of the tubestand, special care must be taken in adjusting the lower bearing. See - "Service Notes" and "Assembly".

17. LOWER RAIL - The lower rail, item 17, figure C-5655 provides a track over which lower bearing may ride smoothly. It is secured to the center legs by means of $3/8 \times 16 \times 1\frac{1}{4}$ inch bolts and to the end legs by $\frac{1}{2} \times 13 \times 2$ inch bolts.

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18. **VERTICAL STEREO SELECTOR** - The vertical stereo selector is shown as item 4, figure C-5651. When vertical stereo work is to be performed by the tubestand, a vertical choice of the following shifts may be made 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6, 6½, and 7 inches. For example, if a six inch stereo shift exposure is to be taken, assuming a target to bucky distance of 72 inches and a vertical carriage index distance of 36 inches, the vertical carriage lock, located to the left of the vertical stereo selector is released. The tube is moved downward vertically until the vertical carriage is set to 33 inches. (Refer to figure C-5651). The stereo lock knob item 13, figure C-5651 is locked. The vertical stereo selector knob, item 4, figure C-5651 is pushed in and turned until it is set to six inches. The entire tube arm is then moved upward until it locks into position automatically. The tubestand is now ready to take a six inch stereo shift exposure. The stereo lock knob, item 13, figure C-5651 or item 2, figure C-5655 must be locked in the desired second stereo position before the stereo selector is set and the tube arm moved.

19. **STEREO RELEASE MECHANISM** - Once the tubestand is set for a stereo exposure, it may be released after the first exposure has been taken by one of two methods. It may be released mechanically by pulling a trip chord fastened to the stereo trip lever, item 10, figure C-5651 or it may be released electrically by energizing a magnetic trip coil, item 12, figure C-5651. When the magnetic type of stereo shift mechanism is employed, an auxilliary push button is operated from the control unit of the high tension generator. A standard female connector is wired to the control unit and plugged into the protruding male connector shown as item 12, figure C-5651.

20. **ROTATION LOCK** - A rotation lock is provided on the square tiebar, mounted parallel to the stereo rod, and located near the horizontal carriage. The purpose of the rotation lock is to enable fixation of the tubestand and prevent rotation when it is undesired. The tube arm is normally held perpendicularly with respect to the tube rail by means of a tactile indicator shown in figure C-5651 as being to the left of the horizontal carriage lock handle.

21. **TUBE ARM ROTATION LOCK** - With the tubestand rotation lock released, and the tube arm perpendicular to the rail mount, the tube may be rotated so that it may be made parallel to the table top regardless of the position of the latter, i.e. the tube may be rotated 90 degrees. To rotate the tube, a convenient rotation lock is provided. This is shown as item 1, in figure C-5648. A tube rotation index scale provided on the vertical carriage to indicate the actual tube rotation in degrees. By means of the rotation index on the vertical carriage and the angulation index on the side of the table parallelism may always be easily obtained by setting the tube arm rotation index to agree with the table angulation index.

22. **FILTER AND CONEHOLDER** - A track is provided in the tube holder to facilitate addition of filters and cones to the tube. A spring catch, item 3, figure C-5648 must be sprung back to enable insertion of the filter or cone.

TERMINAL IDENTIFICATION (REFER TO DRAWING 7709755)

1. **FOOT SWITCH** - A female receptacle is provided in the lower left hand corner of the front leg. The female receptacle is wired to an eight prong Jones connector located on the rear table leg. A special five wire cable is provided to make all connections between the table and control. The cable is equipped with an eight prong Jones female connector. To connect the foot switch to the control unit, plug the five wire interconnecting cable into the side of the table. Connect the two "FS" cable terminals to similarly marked control terminals.

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2. BUCKY - The bucky is connected to Jones plug terminals 5, 6, and 7. The white, BMC, wire connects to Jones plug terminal 6. The green, BC, wire connects to Jones plug terminal 5. The black, BM, wire connects to Jones plug terminal 7. The table bucky is provided with a magnetic release coil whose circuit is completed through a set of normally closed contacts contained within the bucky itself. These contacts are normally open unless the bucky is "cocked". Two other contacts are provided within the bucky for controlling X-ray exposures. These contacts are normally open unless the bucky timing contacts are normally wired in series with the timing contacts of the exposure timer. The electrical contacts are so arranged that operation of the second trigger of the trigger switch applies potential to the BM, BMC terminals which release the bucky. Once the bucky is released, the BM circuit is opened. The bucky timing contacts BC, BMC close after the bucky has reached a predetermined speed. With BC and BMC closed, the exposure is initiated. *NOTE - The exposure should always be terminated by means of the exposure timer and not the timing contacts. Connection to the control is made by means of the three remaining wires of the five conductor table to control interconnecting cable. Cable terminals BM, BMC and BC are connected to similarly marked control terminals.*

3. STEREO RELEASE - The magnetic vertical stereo shift release mechanism is connected to the control unit in the following manner. A female connector, twenty feet of rubber covered cable, a push button and a push button hood are provided to make the above connection.

(1) The rubber covered wire is stripped at one end and secured to the female connector in the usual manner.

(2) The female connector is plugged into the magnetic release unit on the tubestand.

(3) The other end of the twenty foot cable is also stripped and prepared for wiring into the control.

(4) Wire one end of this cable to control stud SM-1.

(5) Wire one end of the stereo release push button to control stud SM-2.

(6) Connect the other end of the magnetic release interconnecting cable to the remaining lead of the push button. Solder and properly tape this junction.

The stereo release push button will be operable only when the control main switch is on. *CAUTION - Do not attempt to make any of the above wiring additions without first turning off the control main switch.*

TABLE ASSEMBLY

The procedure outlined below should be strictly adhered to. The step by step method, if completely followed will enable assembly of the table in the most efficient and direct manner.

1. UNDERCARRIAGE - Place the undercarriage, item 1, figure C-5645, in the desired position. The undercarriage should be located so that the crank mechanism, item 3, figure C-5645 is towards the front. If the tubestand and transformer are to be located in such a position, where final placing of the high tension transformer is impossible, it is recommended that the transformer be located near the rear leg of

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the undercarriage as shown in figure C-5645, before the undercarriage is positioned. Special levelling pads are provided for insertion under the four corners of the undercarriage. Levelling screws are provided within the table legs to enable proper levelling of the table.

2. TABLE TUB - Handling and final positioning of the table tub will require the assistance of at least 4 men. The following procedure should be carefully followed.

a. Carry the tub over to the table undercarriage. It will be noted that one side of the table tub crate is made of heavy lumber, securely bolted to the table tub.

b. Position the tub so that the bottom packing boards of the foot end lie approximately one and one half or two inches from the right side of the front undercarriage leg as viewed in figure C-5657.

c. Place a piece of four by four lumber, approximately forty inches long, under the foot end of the bottom packing boards. Make certain that the piece of four by four is flush with the end of the bottom packing board.

d. Remove all packing boards from the tub with the exception of the heavy bottom pieces.

e. Remove the split bearing retaining screws (item 23, figure C-5657).

f. Remove the top halves of the split bearings (item 23, figure C-5657).

g. Raise the head (narrow) end of the tub slowly until it is in a vertical position.

h. Swing the head end of the tub downward, so that it passes between the two undercarriage legs.

NOTE - Make certain the four X four piece of lumber does not slip as the tub is lowered into position.

i. As the tub pivot pins near the split bearing block on the undercarriage, check for alignment of the drive gear and tub gear, items 16 and 15 figure C-5654. The crank mechanism, item 22, figure C-5657 should be rotated to insure proper gear meshing.

j. When the tub has been lowered sufficiently for the pivot pins to rest in the split bearing blocks, replace the upper halves of the bearings and their retaining screws.

CAUTION - do not release the tub until the upper sections of the bearings have been replaced and the gear mechanism properly meshed.

3. MAIN COUNTERWEIGHTS -

a. When the tub has been properly secured within the undercarriage turn the cranking mechanism, item 22, figure C-5657 until the tub lies in a vertical position.

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b. By means of a suitable wrench, remove the heavy bolts holding the wooden base to the top of the tub.

c. Five main counterweights, numbered one to five are inserted into table tub in the following manner.

d. Remove the main counterweight shipping strap.

e. Insert the counterweights one at a time into their respective positions.

NOTE - Each counterweight is numbered. A corresponding number is marked on the tub to insure proper table balance (See item 13, figure C-5652).

f. Secure each counterweight by means of a proper bolt and lock-washer. (See lower section of figure C-5654.)

g. The three flat counterweights are placed under the foot end table top flange.

h. Secure the three flat counterweights by means of proper flat head screws.

i. Remove the wire tying the horizontal carriage and bucky to the head end of the table.

CAUTION - Before turning the table to a horizontal position, make certain the horizontal carriage lock is in its locked position. (See Paragraph 9, "Fluoroscopic Tower Lock".)

4. FLUOROSCOPIC TOWER -

a. Before inserting the fluoroscopic tower into the horizontal carriage, remove the fluoroscopic tower stop. This is shown as item 28, figure C-5656.

b. Carefully insert the tracks of the fluoroscopic tower, item 3, figure C-5658, into the horizontal carriage roller bearings, item 14, figure C-5656. When the tower is first inserted, make certain that the shutter control cables are clear and do not become entangled with the horizontal carriage. The fluoroscopic tower tracks must also pass between the jaws of a "pincer type" brake. The pincer brake is shown to the left of item 5, figure C-5654.

c. When the tower is properly inserted, replace the tower stop, item 28, figure C-5656.

d. Assemble the fluoroscopic tower lock handle, item 18, figure C-5656, on the horizontal carriage by means of two bolts, item 16, figure C-5656.

5. BUCKY CORD - The bucky cord, item 24, figure C-5656, should be inserted through the insulator bushing into the connecting box, item 27, figure C-5656. The cord should be wired to the eight prong Jones male connector in the following manner.

a. Solder the white, BMC, lead to Jones connector terminal 6.

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- b. Solder the green, BC, lead to Jones connector terminal 5.
- c. Solder the black, BM, lead to Jones connector terminal 7.
(See Drawing 7709755 for Jones connector terminal identification.)
- d. The table should be operated from horizontal to vertical position in order to determine the proper amount of slack needed in the bucky cable.
- e. When the required slack has been determined, wrap a sufficient length of friction tape around the bucky cable to prevent subsequent damage to the bucky soldered connections that may result from cable motion.

CAUTION - In step "D" of this paragraph, it was recommended that the table be shifted from its horizontal position to a vertical position. Since the fluoroscopic screen has not as yet been inserted into the fluoroscopic screen fork there exists a difference in counterbalance between the tower counterweight and the tower assembly. It is recommended that the fluoroscopic tower be moved to the head end of the table and locked into position by means of the fluoroscopic tower lock handle. (Refer to Paragraph 9, "Fluoroscopic Tower Lock"). Failure to observe this precautionary measure may result in damage to the horizontal carriage casting or the horizontal travel stops.

6. FLUOROSCOPIC SHUTTER ASSEMBLY -

- a. With the table in a horizontal position, remove three machine screws holding the protective bottom covering at the foot end of the table.

NOTE - The fluoroscopic tower should be left locked at the head end of the table.

- b. Adjust the table so that it lies in a vertical position. As the table is rotated, bear against the protective bottom covering to prevent any possible binding between the bottom and the undercarriage.

- c. When the table is in a vertical position, remove the remaining three screws holding the protective bottom covering.

- d. Lower the fluoroscopic tower, lock it and secure the fluoroscopic shutter assembly as shown in figure C-5654.

- (1) In positioning the shutter assembly, note that the two shutter control arms lie in a downward position.

- (2) The shutter assembly is held by three round head and one flat head machine screws.

- (3) Figure C-5658 shows the entire shutter unit.

- (4) Item 1 secures the fluoroscopic tube retaining plate and fluoroscopic cone assembly to the shutter base casting.

- (5) Item 2, wing bolt, is provided on the fluoroscopic tube retaining plate to permit the adjustment of

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the fluoroscopic tube assembly, item 4, figure C-5654.

(6) Item 3 is the fluoroscopic tower rail unit.

(7) Item 4 is the fluoroscopic cone assembly.

(8) Item 5 is a spacer for maintaining fixed tube target to table top distance.

(9) Item 6 is the shutter lever arm.

(10) Item 7 is the shutter control cable attachment spacer.

(11) Item 8 is another wing bolt provided to secure the fluoroscopic tube assembly.

(12) Item 9 is the one half millimeter fluoroscopic tube aluminum filter.

(13) Item 10 is the shutter control cable retaining screw.

(14) Item 11 is the other shutter lever arm.

(15) Item 12 is another shutter control cable attachment spacer.

e. After securing the fluoroscopic shutter assembly to the horizontal carriage, assemble the shutter control cables in the following manner. (Refer to figure C-5658).

(1) Loosen the shutter cable retaining screw. (Item 10, figure C-5658.)

(2) Pass the shutter control cable under the retaining washer as shown by item 10, figure C-5658.

(3) Remove the binding head screw from the cable attachment spacer. (Item 7, figure C-5658.)

(4) Make certain that the lower binding head screw on the cable attachment spacer is properly secured by means of the small Allen screw. To test for this, rotate the attachment spacer. Free movement between the cable and the spacer should exist.

(5) Insert the cable attachment spacer into the shutter lever arm, item 6, figure C-5658.

(6) Secure the cable attachment spacer by means of the binding head screw removed in step 3.

(7) Remove the small binding head screw from the other cable attachment spacer (item 12, figure C-5658).

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(8) Repeat the test made in step 4.

(9) Insert the cable attachment spacer, item 12, figure C-5658, into the shutter lever arm, item 11, figure C-5658.

(10) Secure the cable attachment spacer by means of binding head screw removed in step 7. This procedure completes assembly of the shutter control cables and shutter.

7. RAYPROOF TUBE ASSEMBLY

a. Remove the rayproof tube from its shipping carton.

b. Check and make certain whether the small light proof shield is inserted into the rayproof tube windows.

c. The rayproof tube is assembled in the following manner. (Refer to figure C-5649.)

(1) Remove two screws from each of the split clamps. (Items 4 and 8, figure C-5649.)

(2) Remove the two upper halves of the split clamps. (Items 5 and 9, figure C-5649.)

(3) Insert the rayproof tube into the lower half of the clamp. It will be noted that both halves of the tube clamp are provided with four small rubber bumpers. Make certain all bumpers are in position before re-assembly of the tube clamp.

(4) The rectangular window of the rayproof tube must project into the small micarta lead lined ring secured to the tube adapting panel.

(5) Roughly center the rayproof tube with respect to the small circular lead lined micarta ring.

(6) Replace the two upper halves of the split clamps, items 5 and 9, figure C-5649.

(7) Replace the four clamp retaining screws.

(8) Tighten the split clamps sufficiently to hold the tube in a vertical position.

(9) Secure the cathode porcelain supporting insulator to the lower half of the rayproof tube clamp, item 4, figure C-5649. The cathode porcelain supporting insulator is shown as item 1, figure C-5649.

(10) Loosen the small anode connector knurled nut and place the flexible anode connecting lead into position under this nut. Secure the nut after performing this operation.

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(11) Check the small flat head machine screws upholding the anode reel supporting strip. Make certain they are secured.

(12) Check the anode reel, item 12, figure C-5649. Make certain it is properly secured.

The completely assembled rayproof tube, ready for attachment to the tube retaining panel, item 2, figure C-5654, is shown in Figure C-5649.

8. ASSEMBLY OF THE RAYPROOF TUBE ON TO THE FLUOROSCOPIC TOWER UNDERCARRIAGE

a. With the table in a vertical position, as shown in figure C-5654, remove the two wing nuts, item 6, figure C-5654.

b. Insert the complete rayproof tube assembly as shown in figure C-5654.

c. Replace the two wing nuts removed in step "a" of this paragraph.

9. ASSEMBLY OF ANODE CABLE IN TABLE - The anode cable is differentiated from the cathode cable in that the former has one conductor. The cable is assembled within the table in the following manner. (Refer to drawing 3A-1655.)

a. Secure the upper end of the anode cable, i.e. end without large nut, to the head end of the table by means of cable clamp, item 10, drawing 3A-1655.

b. Ground the cable outer sheath by means of the special wire attached to the anode cable.

CAUTION - Failure to ground the high tension cable may result in a broken down cable.

c. Secure the isolantite insulator, item 19, as shown by means of a $\frac{1}{4}$ X 20 machine screw. A hole is provided at the head end of the table to secure the isolantite insulator.

d. Run the anode high tension cable along the left side of the table as viewed from the rear.

e. Secure the cable by means of the clamps provided. (Item 1, drawing 3A-1655.)

f. The final turn of the high tension cable before it emerges from the table may be seen in figure C-5654.

g. Insert the cable into the cable clamp, item 11, figure C-5652.

h. Assemble the split cable clamps as shown by item 11, figure C-5652. When the anode cable is initially installed, allow enough cable slack to permit the table to be adjusted to its horizontal position without making too sharp a bend in the cable. The cable clamps should be properly secured after the proper cable slack has been determined.

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- i. Connect the single conductor emerging from the high tension anode cable sheath and the anode reel interconnecting lead to the isolantite insulator, item 19, drawing 3A-1655.

NOTE - See figure C-5654 for further details regarding the anode high tension cable.

10. CATHODE HIGH TENSION CABLE ASSEMBLY - The cathode cable is made of three conductors and is shown as item 1, figure C-5652. The cable should be connected in the following manner.

- a. Loosen the two flat head machine screws holding the cathode sheath clamp into position.

- b. Insert the cathode insulator sheath through the clamp and secure it.

- c. Ground the sheath of the cathode high tension cable by means of the special ground wire attached. The ground wire is shown in position in the lower center of figure C-5652.

CAUTION - Failure to properly ground the cable outer sheath may result in a broken down high tension cable.

- d. Clamping details of the cathode high tension cable are shown by item 11, figure C-5654.

- e. Insert the cathode high tension cable into its clamp, item 1, figure C-5652.

- f. Assemble the split cable clamps as shown by item 1, figure C-5652.

When the cathode cable is initially installed, allow enough cable slack to permit the table to be adjusted to its horizontal position without making too sharp a bend in the cable. The cable clamps should be properly secured after the proper cable slack has been determined.

- g. The three flexible cathode high tension cable connectors should be wired in the following manner. Let the left reel, when viewed as in figure C-5654, be the "L" terminal; the center reel becoming "S" and the extreme right reel being "C".

11. CATHODE SOCKET ASSEMBLY - The cathode socket, item 6, figure C-5654 is wired to the high tension cathode reels in the following manner.

- a. Remove a single flat head machine screw holding the bottom cover in position

- b. It will be noted that the three terminal studs on the cathode socket have been marked "C", "S" and "L".

- c. Wire the three cathode reels, (see paragraph 10G) to similarly marked socket studs.

- d. Replace the socket protective cover and small flat head machine screw.

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e. Secure the cathode reel connecting wires to the cathode porcelain supporting insulator, item 5, figure C-5654.

f. Insert the cathode socket into the tube base.

NOTE - The cathode socket is of the polarized type. It is therefore essential that the cathode pins and cathode socket be properly aligned before insertion of the cathode socket is attempted.

12. **FLUOROSCOPIC SCREEN** - The fluoroscopic screen, item 11, figure C-5657 is assembled in the following manner. (Refer to Assembly Drawing C-5653.)

a. Place the micarta screen protective panel, item 7, the screen backing, item 9, the fluoroscopic screen, item 10 and the lead glass, item 11, as shown in figure C-5653.

b. Place the four wooden shim strips about the edges of the screen unit as assembled in paragraph 12-A.

c. The screen retaining frame, item 12, figure C-5653 should be placed with the holes for the screen retaining locks in an upward position.

d. The screen retaining strips, items 2 and 5, figure C-5653 should be removed.

e. Remove the screen handles, items 3 and 4, figure C-5653.

f. With the screen retaining frame, item 12, in the position outlined in paragraph 12-C, insert the screen unit so that the lead glass is in an upward position. It may be necessary to shave the small wooden shims, item 8, to provide a tight fit. (Refer to figure C-5653.)

g. Replace the screen handles, items 3 and 4, figure C-5653.

h. Replace the screen retaining strips, items 2 and 5, figure C-5653.

i. Insert the fluoroscopic screen into its retaining fork.

NOTE - The screen retaining locks, item 7, figure C-5657 should be raised and twisted so that they permit insertion of the screen. After the screen is placed in position with the lead glass upward as shown by item 11, figure C-5657, secure the screen retaining locks, item 7, figure C-5657.

It is recommended that the table be placed in a horizontal position while the screen is inserted. The fluoroscopic tower will be properly counterbalanced when the fluoroscopic screen is installed.

CAUTION - The fluoroscopic screen should never be removed from the screen fork without first setting the fluoroscopic tower to the head end of the table, and locking it into position. Failure to observe this precautionary measure may result in a broken horizontal carriage.

13. **TABLE TOP ASSEMBLY** - Place the table top in position. It should be noted

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that the underside of the table top is marked "Top". This end of the table top is placed towards the head end of the table. (Narrow end of the Table.)

a. Place the angle strips, item 2, figure C-5657 in position as shown in figure C-5657. The strips should be checked for alignment of holes before any attempt is made to secure them.

b. Secure the table top by means of the Phillips screws provided.

c. Secure the angle strips by means of the Phillips screws provided.

d. Secure the compression device rails, item 3, figure C-5657 by means of special Phillips screws and rail spacers provided.

TUBESTAND ASSEMBLY

The procedure outlined below should be strictly adhered to. The step by step method if completely followed will enable assembly of the tubestand in the most efficient and direct manner.

1. LOWER RAIL - The lower rail is provided with four tapped holes to enable attachment of the two center legs and two outer legs.

The legs are secured to the rail in the following manner:

a. By means of $3/8 \times 16 \times 1\ 1/2$ bolts secure the center legs to the lower rail.

b. Secure the left leg to the lower rail by means of a $1/2 \times 13 \times 2$ inch bolt.

NOTE - Lockwashers should be used to secure all bolts.

2. UPPER RAIL - The upper rail with the horizontal and vertical scales is mounted so that the scales may be read from the front of the table.

With the upper rail in this position the 52 inch scale will read toward the head (narrow) end of the table.

a. Secure the upper rail to the center legs. Use $3/8 \times 16 \times 1\ 1/4$ inch bolts.

b. Secure the left leg to the upper rail. Use $1/2 \times 13 \times 2$ inch bolts. Before placing the upper rail into the retaining boss on the left leg, slide the circular rubber bumper over the rail.

NOTE - Lockwashers should secure all bolts.

3. HORIZONTAL CARRIAGE - The horizontal carriage, item 12, figure C-5655, is placed into position on top rail before the right leg is assembled to the rails.

a. The horizontal carriage lock, item 11, figure C-5655 is released as far as it will go.

b. The carriage is inserted so that the roller bearings engage the

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top rail. The carriage lock, item 11, figure C-5655 is securely locked once the carriage is properly inserted.

c. Secure the right leg to the lower rail. Use a 1/2 x 13 x 2 inch bolt.

d. Slip the rubber bumper over the top rail as shown in figure C-5655.

e. Secure the right leg to the upper rail. Use a 1/2 x 13 x 2 inch bolt.

NOTE - Secure all bolts with lockwashers.

CAUTION - When placing the horizontal carriage in position over the top rail make certain that the small "Horizontal" nameplate points towards the 52 inch scale on the top rail.

4. **TUBESTAND COLUMN** - The horizontal carriage is provided with a split clamp to enable attachment of the tubestand column to the railmount assembly.

The two machine screws, as well as the split clamp should be removed before any attempt is made to mount the column into position.

a. Secure the lower bearing, item 16, figure C-5655 to the bottom of the tubestand column.

b. Make certain that the lower bearing is in line with the counterweight chain before attempting to place it over the lower rail.

c. Place a 10 inch piece of 2 x 4 approximately 15 inches from the right leg. The 2 x 4 should be set with its four inch dimension upwards. The purpose of this block is to provide a means of removing any possible overload to the lower bearing.

d. Carry the tubestand column over to the railmount.

e. Place the column so that the lower section rests on the 2 x 4 block.

f. Raise the column, and slide the lower bearing over the lower rail.

CAUTION - Do not permit the lower bearing to support the weight of the entire column. Failure to observe this precautionary measure may result in a broken lower bearing.

g. Place the 2 x 4 under the lower end of the column after the lower bearing is positioned.

h. Replace the split clamps and secure the tubestand column to the horizontal carriage.

i. Adjust the heights of the column with respect to the horizontal carriage so that the tactile indicator is properly positioned.

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j. Rotate the lower bearing slightly, if necessary, to take up any possible play between the column and lower rail.

5. TUBE ARM - The tube arm is attached to the tubestand column after the operations outlined in step 4 have been performed

a. Remove the machine screw holding the tubestand counterweights in their shipping position.

Note that the tube arm angulating lock pin is attached to the tube arm.

b. Remove the lock pin and position it within the tube arm retaining boss.

c. Secure the tube arm retaining bolt after inserting the tube arm into position.

NOTE - To facilitate addition of the tube arm it is recommended that the vertical tubestand carriage be lowered to a convenient working height.

Since the tubestand vertical carriage has no tube arm, it is in an unbalanced condition. Therefore the vertical carriage should be securely locked in position before an attempt is made to insert the tube arm.

After assembly of the tube arm it is necessary that the carriage be left securely locked until the radiographic tube is permanently mounted on the tube arm.

6. ALIGNMENT - The method of alignment listed below should be carefully followed before any attempt is made to secure the tubestand to the floor.

a. Tie a piece of heavy twine between the two tube adaptor plate retaining nuts, item 8, figure C-5655. It is recommended that the twine be wound around the studs into which item 8 is secured.

b. Adjust the height of the tube arm to be approximately 20 inches from the table top. To do this unlock the vertical carriage lock, at the same time holding the tube arm securely. Move the vertical carriage until the distance recommended above is obtained.

c. Carefully measure the inner-diameter of the tube retaining casting.

d. Mark the center of the twine by means of a pencil.

e. Secure a plumb from this point and adjust its height so that it is approximately 1/8 inch from the table top.

f. Make certain that table undercarriage is in the desired position before proceeding any further.

g. Adjust the table so that it is in a horizontal position.

h. Check the table for levelling by means of a level. Adjust the levelling pads if necessary.

i. Adjust the fluoroscopic tower so that its center-line indicator

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is opposite 27 on the bucky scale.

j. Carefully mark the center of the fluoroscopic screen glass by removing the screen from the screen fork and placing a straight edge diagonally across the screen assembly. It will be found useful to use some sort of colored chalk in marking this center line.

NOTE - The center line is marked on the glass.

k. Lock the tower into position at the "27" index point.

j. Operate the screen and fork rotation safety lock, item 12 figure C-56 57.

m. Operate the rotation safety lock and the screen-fork rotation lock, item 8, figure C-56 57 backwards and swing the screen-fork assembly to the left.

n. Turn the screen rotation lock and swing the screen so that it becomes perpendicular to the table top.

o. Swing the screen-fork assembly to the left until it is parallel with the fluoroscopic tower unit.

This enables the plumb to be moved along the length of the table and check parallelism between table and tubestand.

p. Set the tube arm horizontal carriage so that its center line is opposite zero on the horizontal stereo scale.

q. Secure the tube arm horizontal carriage in this position.

r. Release the tubestand horizontal carriage lock and run the tubestand up and down along the railmount; check for alignment between the plumb and the longitudinal line on the table top.

s. Adjust the railmount until it is parallel with the table center line.

t. Run the tubestand to the foot end of the table.

u. With the horizontal carriage locked at the "27" index return the screen fork assembly to its normal position as shown in figure C-56 57.

v. Raise the tubestand vertical carriage to its uppermost position.

w. Move the tubestand so that the plumb is in the exact center of the fluoroscopic screen. It may be necessary to either lower the fluoroscopic screen or tubestand vertical carriage in order to bring the plumb approximately 1/8 inch from the screen lead glass.

CAUTION - If the screen assembly is lowered make certain that the fluoroscopic tower center line indicator is not disturbed from its previous setting.

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x. With the plumb directly above the screen center reference the horizontal scale index as indicated by the left end of the tubestand horizontal carriage should coincide with the "27" bucky scale index.

y. If necessary adjust the railmount until these readings coincide.

z. If the railmount is moved repeat steps R and S of this paragraph.

7. FIXATION OF RAILMOUNT TO FLOOR - The railmount may be secured to the floor once steps A to Z in paragraph 6 have been completed.

The railmount may be fixed to a concrete floor in the following manner.

a. By means of a "star drill", drill 8, 7/16 inch holes 1 3/4 inches deep.

In drilling the 8 mounting holes care should be taken not to move the railmount.

b. After drilling 8 mounting holes insert 8 special rawl plugs.

c. Lightly drive the rawl plugs until they reach the bottom of the mounting holes.

d. Insert a special 2 1/2 inch lag screw, provided with its proper washer, in each mounting hole.

e. Secure the railmount by tightening the 8 lag screws.

f. Check for table to tubestand alignment, as outlined in paragraph 6, after securing the railmount.

g. For fixation of the railmount to wooden floors proceed as follows:

h. Drill a 3/16 inch hole centrally within each mounting hole. Drill to a depth of approximately two inches.

i. Insert a special 2 1/2 inch lag screw, provided with its proper washer, in each mounting hole.

j. Secure the railmount by tightening the 8 lag screws.

k. Check for table to tubestand alignment, as outlined in paragraph 6, after securing the railmount.

ASSEMBLY OF HIGH TENSION TRANSFORMER

The S#979967, 200 ma, 110 KV, high tension transformer is provided with four high tension outlets. There are two outlets for the fluoroscopic tube and two for the radiographic tube.

The radiographic outlets are stamped "U"; the fluoroscopic outlets are stamped "L".

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The high tension transformer is located between the center railmount legs as shown in figure C-5655.

The cathode outlets should be so positioned that they normally lie towards the foot end of the table; i.e. towards the right when viewing the transformer from the front of the table.

The cathode outlets are provided with a three prong socket while the anode outlets have a single prong socket.

After installing the valve tubes and connecting the transformer as outlined under "Assembly" in "Control Instructions" 57-853 proceed as follows.

a. Secure the anode and cathode cables to the bottom of the lower rail. Small clamps as well as tapped holes in the lower rail are provided.

The tapped holes are located about 12 inches from the left leg of the railmount.

b. Secure the fluoroscopic anode cable to the side of the transformer cover as shown in figure C-5645.

c. Secure the cathode cable to the two center legs as shown in figure C-5656.

d. Ground the table undercarriage to the transformer as shown by item 2, figure C-5656.

A special hole has been provided on the rear leg of the undercarriage for purposes of adding a ground wire.

The special hole is located directly below the terminal box top panel, item 27, figure C-5656.

e. Insert the fluoroscopic cathode cable, item 7, figure C-5656 into the fluoroscopic cathode socket. Make certain that the cable is properly inserted before securing the lock nut.

f. Insert the fluoroscopic anode cable into the fluoroscopic anode socket.

g. Insert the radiographic anode cable, item 8, figure C-5657, into the radiographic anode socket.

h. Insert the radiographic cathode cable, item 9, figure C-5656 into the radiographic cathode socket.

i. Remove the roller retaining acorn nut, item 17, figure C-5656 and the anode cable roller. Insert the anode cable into its tracks.

j. Replace the upper anode cable roller and acorn nut, item 7, figure C-5656.

k. Remove the roller retaining acorn nut and cathode cable roller. Insert the cathode cable into its roller tracks.

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- (1) Replace the upper cathode cable roller and acorn nut.

FINAL ADJUSTMENTS

1. ASSEMBLY OF SHOCKPROOF TUBEHEAD -

- a. Mount the shockproof radiographic tube on the tube adapting panel.

- b. Mount the adapting panel on the tube arm horizontal carriage and secure it by means of two retaining nuts, item 8, figure C-5655.

- c. Apply vaseline to the anode cable tube insert, (two prong plug) after having thoroughly cleaned it with a lint free cloth and carbon tetrachloride.

- d. Insert the anode cable into the shock-proof tubehead. It is recommended that the anode insert be worked back and forth several times in order to exclude all air from the tube anode

- e. Secure the anode cable to the shockproof tubehead by means of the cable nut.

- f. Apply vaseline to the cathode cable tube insert, (three prong plug), after having thoroughly cleaned it with a lint free cloth and carbon tetrachloride.

- g. Insert the cathode cable into the shockproof tubehead. It is recommended that the cathode insert be carefully worked back and forth several times in order to exclude all air from the tube cathode socket.

- h. Secure the cathode cable to the shockproof tubehead by means of the cable nut.

NOTE - The tubestand horizontal carriage is now properly counterbalanced, and the precautionary measures regarding unbalance of the horizontal carriage need be adhered to only in cases where the shockproof tube is removed.

2. TABLE HIGH TENSION SYSTEM - Before applying high tension to the table fluoroscopic tube it is essential that the following operations are performed.

- a. Thoroughly clean the cathode reel insulators with lint free cloth and carbon tetrachloride.

- b. Thoroughly clean the cathode reels with lint free cloth.

- c. Thoroughly clean the cathode high tension inlet cable sheath with lint free cloth and carbon tetrachloride.

- d. Thoroughly clean the anode high tension inlet cable sheath with lint free cloth and carbon tetrachloride.

- e. Thoroughly clean the anode porcelain insulator with lint free cloth and carbon tetrachloride.

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f. Make certain that both anode and cathode cable outer sheaths are properly grounded.

g. Make certain that the table undercarriage is properly grounded.

3. **FLUOROSCOPIC TUBE** - The fluoroscopic tube must be properly adjusted once it has been installed in the table. Adjustment of the tube is made in the following manner.

a. Turn on main line switch.

b. Turn both filament regulators to their extreme clockwise position.

c. Set the potential dials to 30 KV.

d. Plug the eight prong female connector into rear table leg.
(Refer to Terminal Identification:)

NOTE - Before turning on the control main "on", "off" switch make certain that the table to control interconnecting cable is connected as outlined in Terminal Identification.

e. Plug the foot switch into the front table leg.

f. Adjust the table to its vertical position.

g. Operate the control main, "on", "off" switch.

h. Set the "Fluoroscopic-Radiographic" switch to its fluoroscopic position.

i. After taking all precautionary measures against x-rays and high tension, operate the foot switch. Note the milliamperage. The 0-20 range of the milliammeter should be connected.

j. Adjust the milliamperage for 3 ma.

k. Remove foot from foot switch.

l. Raise kilovoltage to 50 KV.

m. All adjustments of the fluoroscopic tube should be made at 50 KV and 3 to 4 ma.

n. Close both fluoroscopic shutters until an image of approximately 2 x 2 inches forms on the screen.

o. If the image is above the center reference line on the fluoroscopic screen raise the fluoroscopic tube slightly.

CAUTION - Always turn off the control main switch before attempting any adjustments of the fluoroscopic tube.

p. If the image is below the center reference line on the fluoroscopic screen lower the fluoroscopic tube slightly.

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

NOTE - In all cases of raising or lowering the fluoroscopic tube it will be necessary to loosen the fluoroscopic tube split clamps.

q. If the image is to the left of the center reference line on the fluoroscopic screen rotate the fluoroscopic tube slightly to the right.

r. If the image is to the right of the center reference line on the fluoroscopic screen rotate the fluoroscopic tube slightly to the left.

NOTE - Adjustment of the fluoroscopic tube should be made with the least possible time of application of high tension to the fluoroscopic tube. The safe tube ratings should never be exceeded.

s. Once the fluoroscopic tube has been adjusted replace the protective table bottom.

t. Remove the reference chalked center lines from the fluoroscopic screen lead glass.

OPERATION

WARNING - This x-ray equipment is dangerous to both patient and operator unless established safe factors are strictly observed.

X-RAY TUBE LIFE - The Westinghouse Special Fluoradex generator has been provided with every practical facility for minimizing the possibility of incorrect electrical or mechanical operation. However, certain responsibilities, particularly those governing satisfactory x-ray tube life, still attach themselves to the individual operator. A thorough familiarity with permissible full-wave MILLIAMPERAGE, KILOVOLTAGE and Time ratings as outlined on the tube manufacturers chart is therefore of the utmost importance if economical and trouble free operation is to be expected.

After taking all necessary precautions against high voltage and exposure to x-rays, proceed as follows:

1. FLUOROSCOPIC OPERATION -

a. Set the Operation selector to the Fluoroscopic Position.

b. Set both potential dials to the desired kilovoltage. DO NOT EXCEED THE SMALL FOCAL SPOT VALUES SHOWN ON THE FLUOROSCOPIC TUBE RATING CHART FOR FULL WAVE OPERATION.

c. Throw the control main switch to its "on" position.

d. Adjust the Line Voltage regulator until the line voltmeter reads zero.

e. Refer to the fluoroscopic calibration form at the end of the control instructions.

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

NOTE - This calibration should be made, and filament preset and other values entered at the time of installation. However, the low M.A. preset values shown on the preliminary radiographic form may be tentatively used, but with caution as a basis for preliminary fluoroscopic calibration.

f. Preset the lower (fluoroscopic) filament regulator to the value shown on the fluoroscopic form for the milliamperage selected. **DO NOT EXCEED THE MAXIMUM SMALL FOCAL SPOT VALUES SHOWN ON THE FLUOROSCOPIC TUBE RATING CHART FOR FULL WAVE FLUOROSCOPIC OPERATION.**

g. Step on the foot switch and observe the milliammeter (**X-RAYS ARE NOW BEING GENERATED**). The actual value in milliamperes should be indicated on the low (0-20) scale. If the milliammeter does not indicate the exact value selected, the fluoroscopic filament regulator may be adjusted while x-rays are on until the desired reading is obtained. After releasing the foot switch the no load, (x-rays off) filament meter reading for the indicated milliamperage should be recorded on the blank fluoroscopic calibration at the end of the control instructions for future reference.

SERVICE NOTES

1. **MAIN TABLE BEARINGS** - The main table bearings, item 23, figure C-5657 should be periodically greased.

The table should always be adjusted to its horizontal position before any attempt is made to remove the split bearings and apply grease.

CAUTION - Never attempt to remove the split bearings with the table in a vertical position.

2. **FLUOROSCOPIC HIGH TENSION SYSTEM** - The fluoroscopic high tension system should be periodically cleaned with lint free cloth and carbon tetrachloride.

The table protective bottom covering is removed and the following high tension components cleaned.

NOTE - Lint free cloth and clean, dry carbon tetrachloride should be used.

- a. Clean the anode porcelain supporting insulator.
- b. Clean the anode inlet high tension cable sheath.
- c. Clean the cathode reel supporting insulators.
- d. Clean the cathode inlet high tension cable sheath.

3. **FLUOROSCOPIC SCREEN** - The fluoroscopic screen, item 11, figure C-5657 should under no conditions be exposed to sunlight.

Failure to observe this precautionary measure will seriously impair the relative brightness of the screen when used for fluoroscopic examinations.

The screen assembly should always be removed from the screen fork when the screen is likely to be exposed to sunlight.

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

4. SPARKING OVER BETWEEN THE ANODE RADIATOR AND RAYPROOF TUBEHEAD - On dry crisp days occasional "pecking" may be heard within the table tube. Cause of this "pecking" may be due to a high accumulation of static charge on the anode end of the rayproof housing which leaks off to the anode radiator.

This difficulty may be eliminated by placing a little glycerine along the top surface of the rayproof housing directly under the radiator. It is important that medicinal glycerine be used for this purpose, and the glycerine be applied around the entire top of the rayproof housing.

5. COUNTERWEIGHT CABLES - The bucky and tower counterweight cables should be periodically inspected for wear. The cables should be immediately replaced if any sign of "Fraying" is apparent.

6. VERTICAL STEREO RELEASE - The vertical stereo mechanism should be periodically inspected for operation. If the horizontal stereo release is too rapid, the following tests should be made.

a. Remove one or more of the stereo counterweights, item 11, figure C-5656.

b. "Cock" the stereo and then release it. If the stereo mechanism does not permit the tube arm to drop, lock the stereo lock mechanism, item 13, figure C-5651.

c. Set the stereo selector, item 4, figure C-5651 for a 7 inch stereo.

d. Raise the tube arm upward until it automatically locks.

e. Remove the stereo release mechanism oil cap, item 6, figure C-5651.

f. Check the oil level. If a deficiency in oil is apparent, add enough oil to raise the level 1/8th of an inch.

g. Replace the oil cap, item 6, figure C-5651.

h. Release the tube arm and check the rate of fall. A careful balance between counterweights, item 11, figure C-5656 and oil level must be maintained to insure smooth and trouble free stereo operation.

i. Slow release in stereo shift, (vertical) may be due to insufficient counterweights, item 11, figure 5656 or to too much oil.

CAUTION - Always lock the stereo lock, item 13, figure C-5651 and "Cock" the tube arm to its maximum stereo shift position before attempting to remove the oil cap, item 6, figure C-5651.

7. LOWER BEARING - Play between the tubestand vertical column and the lower rail may be due to improper adjustment of the lower bearing. The play may be eliminated by twisting the lower bearing slightly.

8. DRIVE CHAIN - A small set screw is provided on the left side of the front undercarriage leg. The set screw is used to take up any slack that may occur in the drive chain through wear.

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

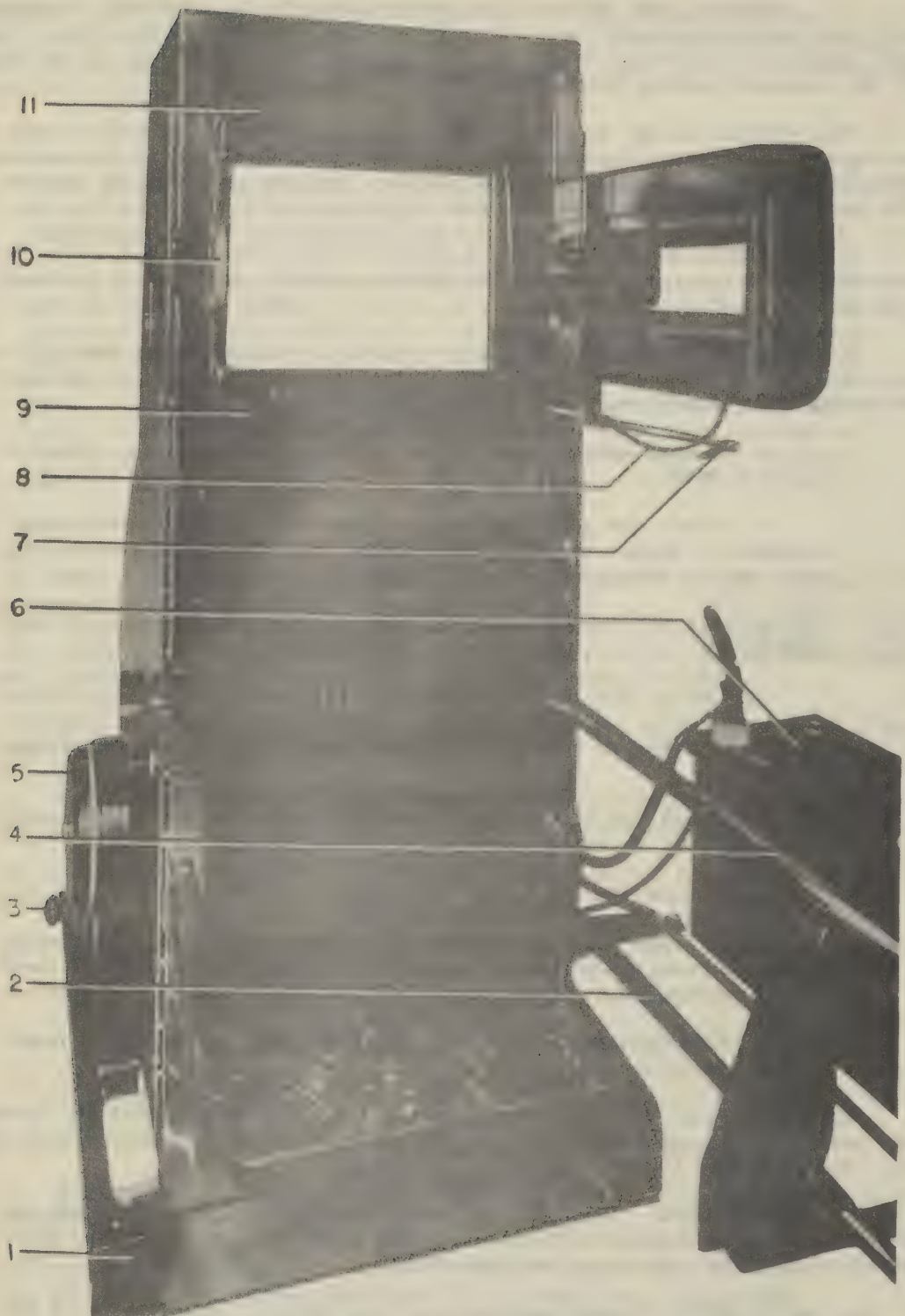


FIG C-5645

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

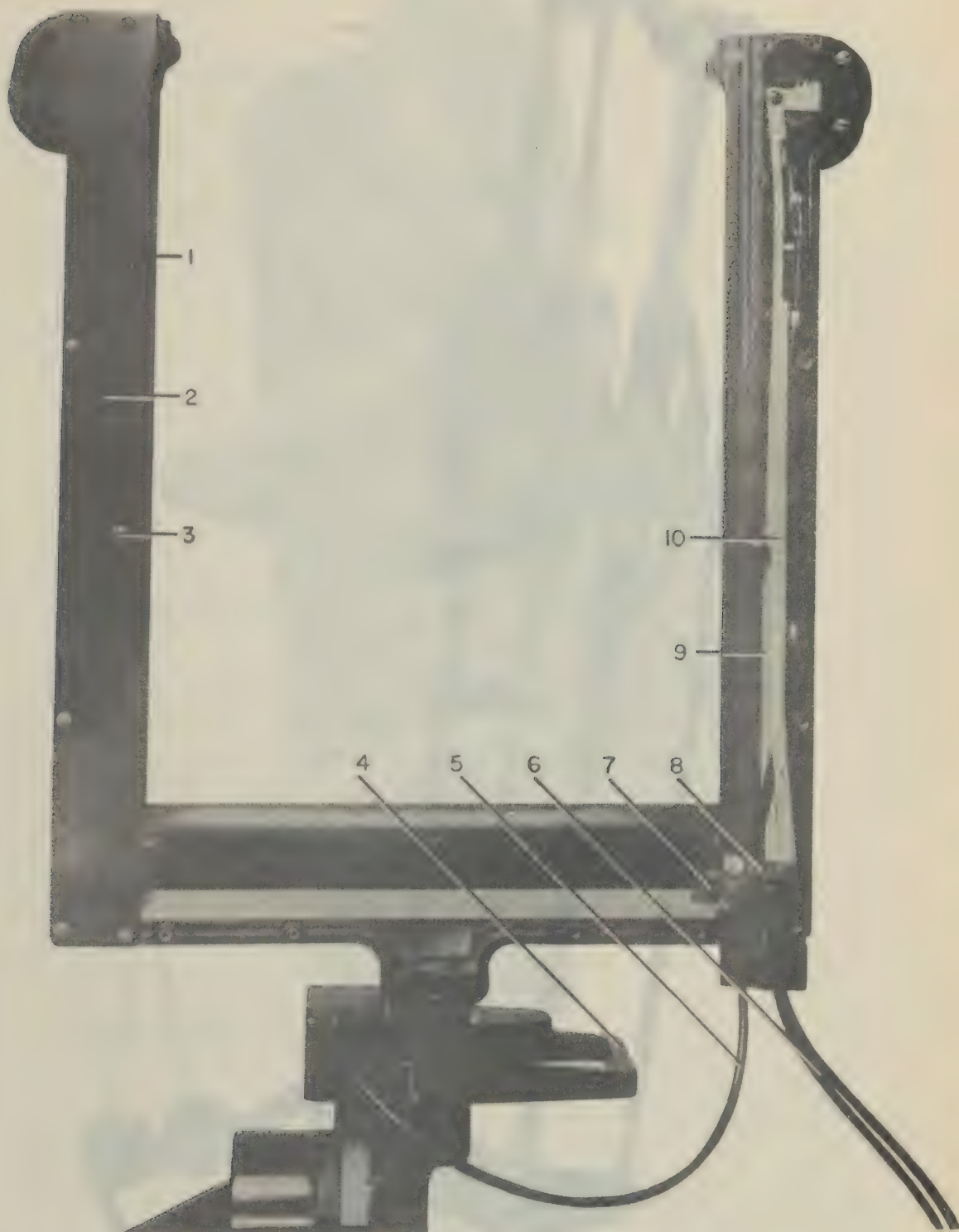


FIG. C-5646

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

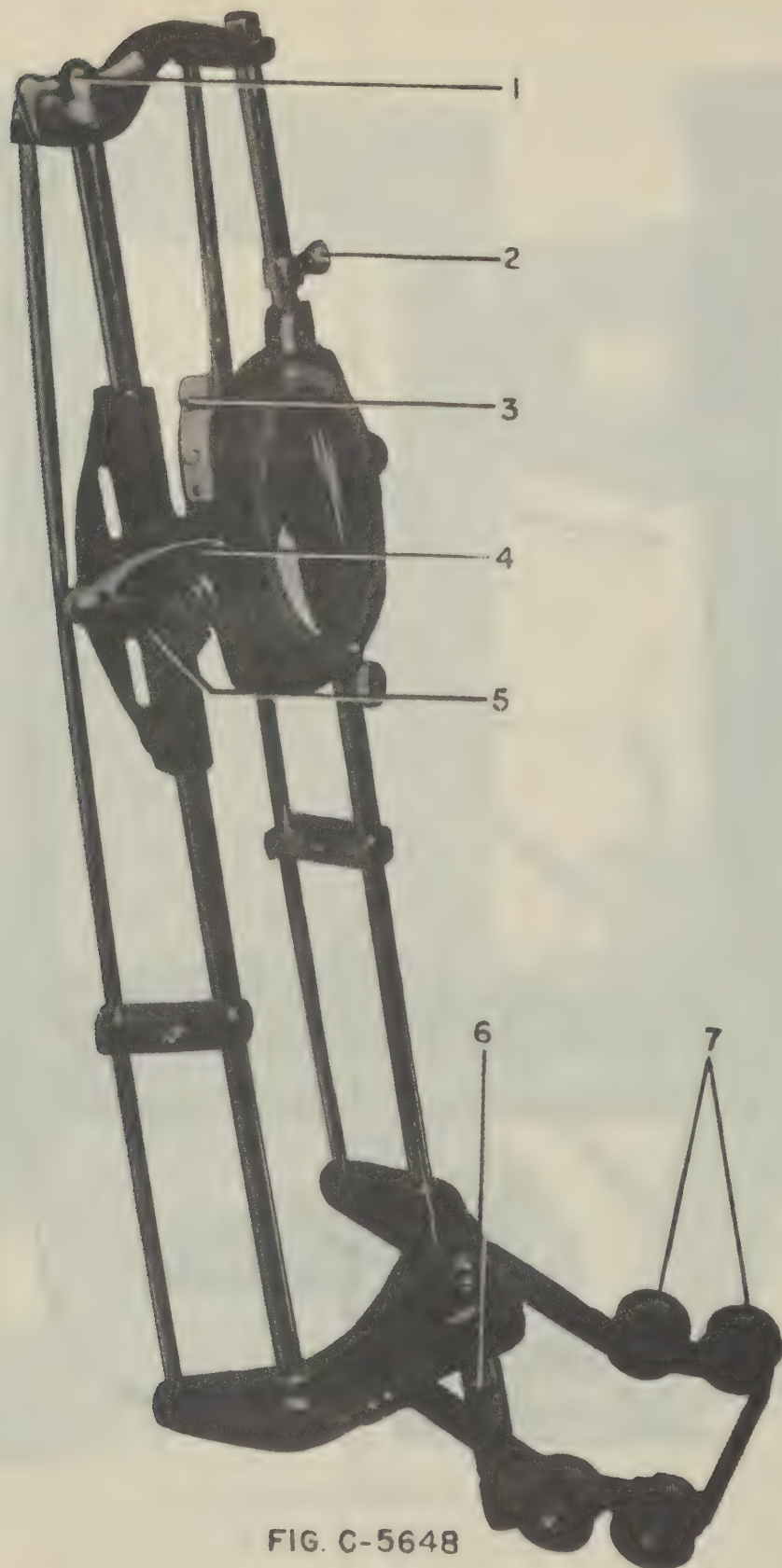


FIG. C-5648

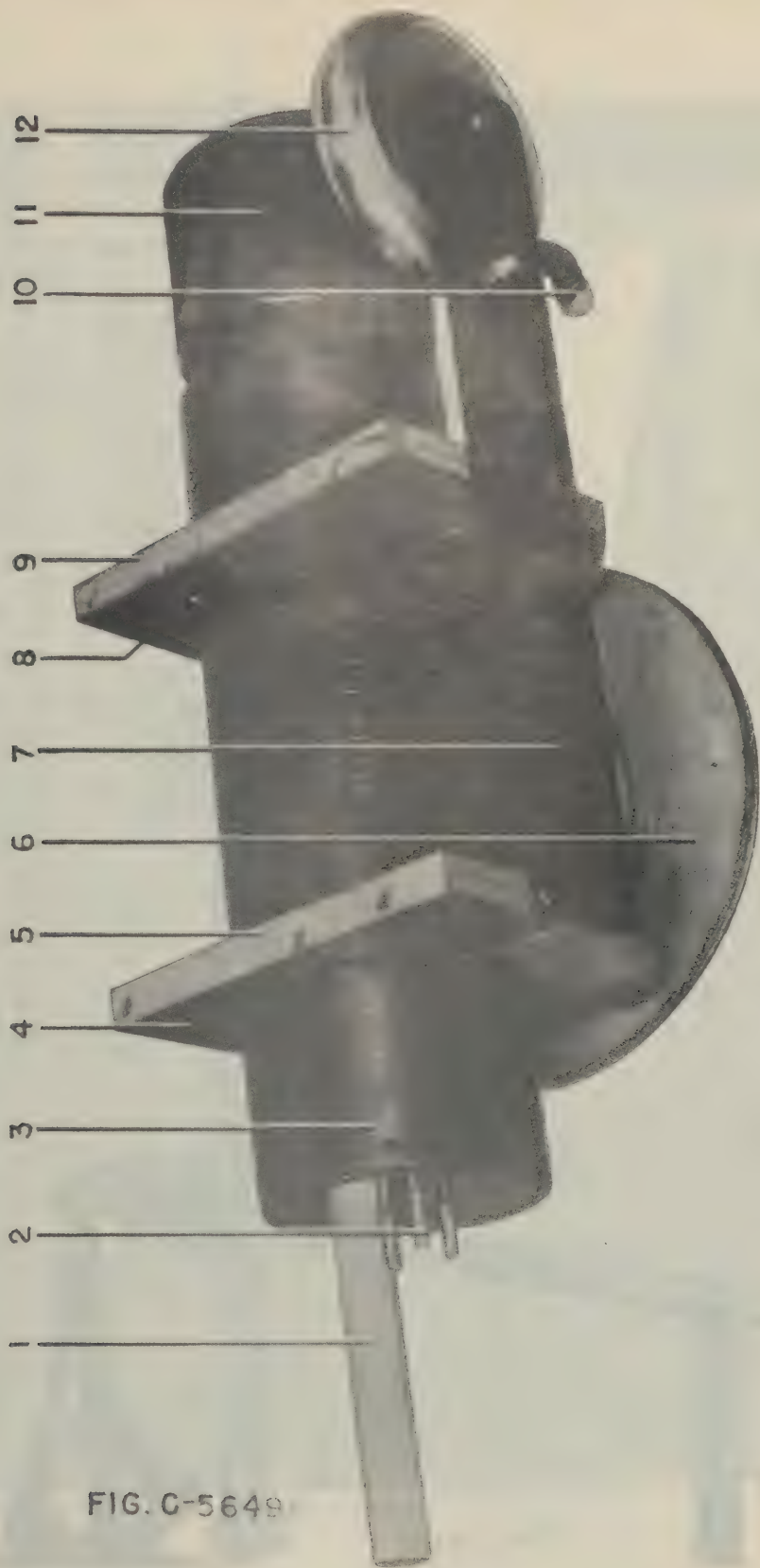


FIG. C-5649

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

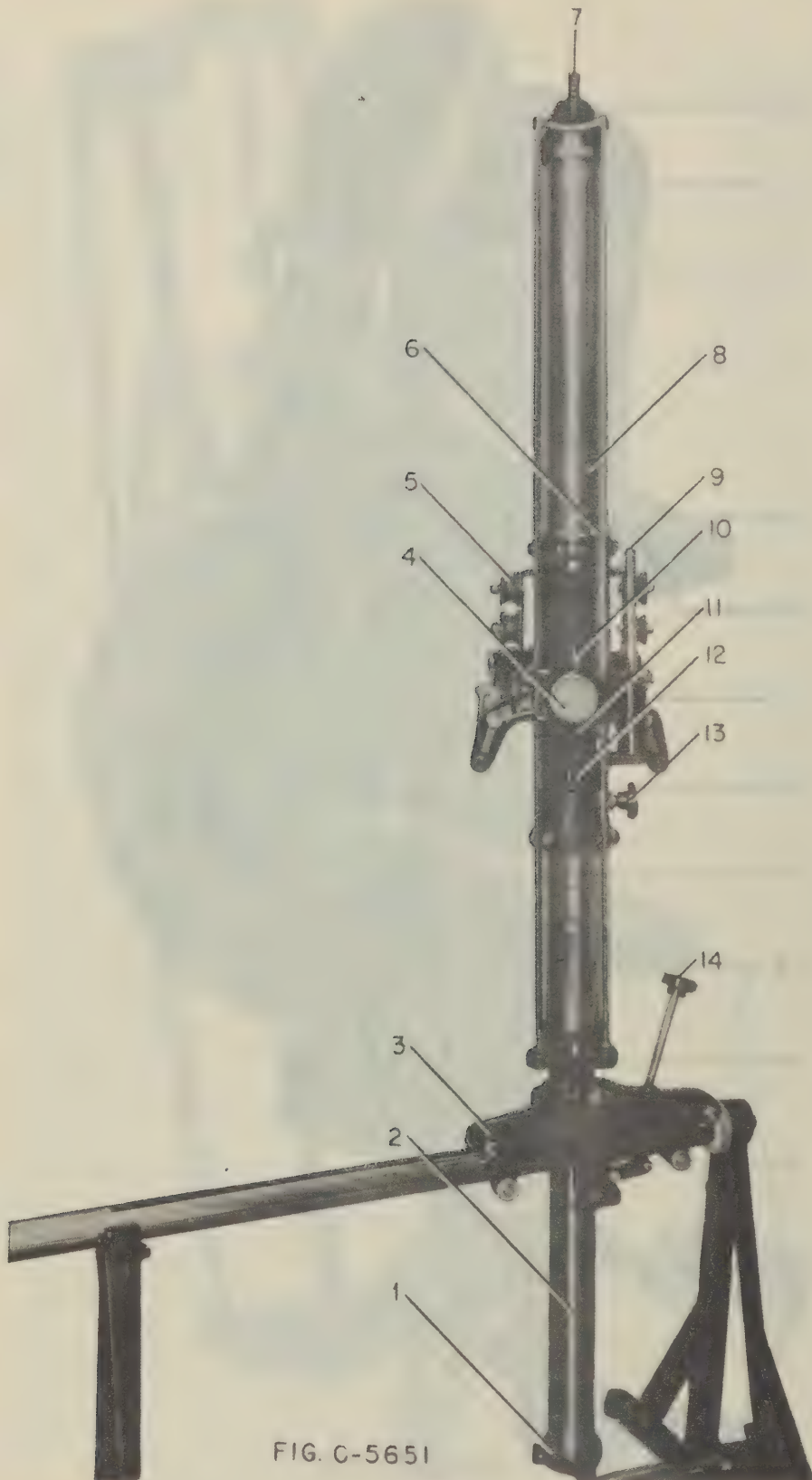


FIG. C-5651

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

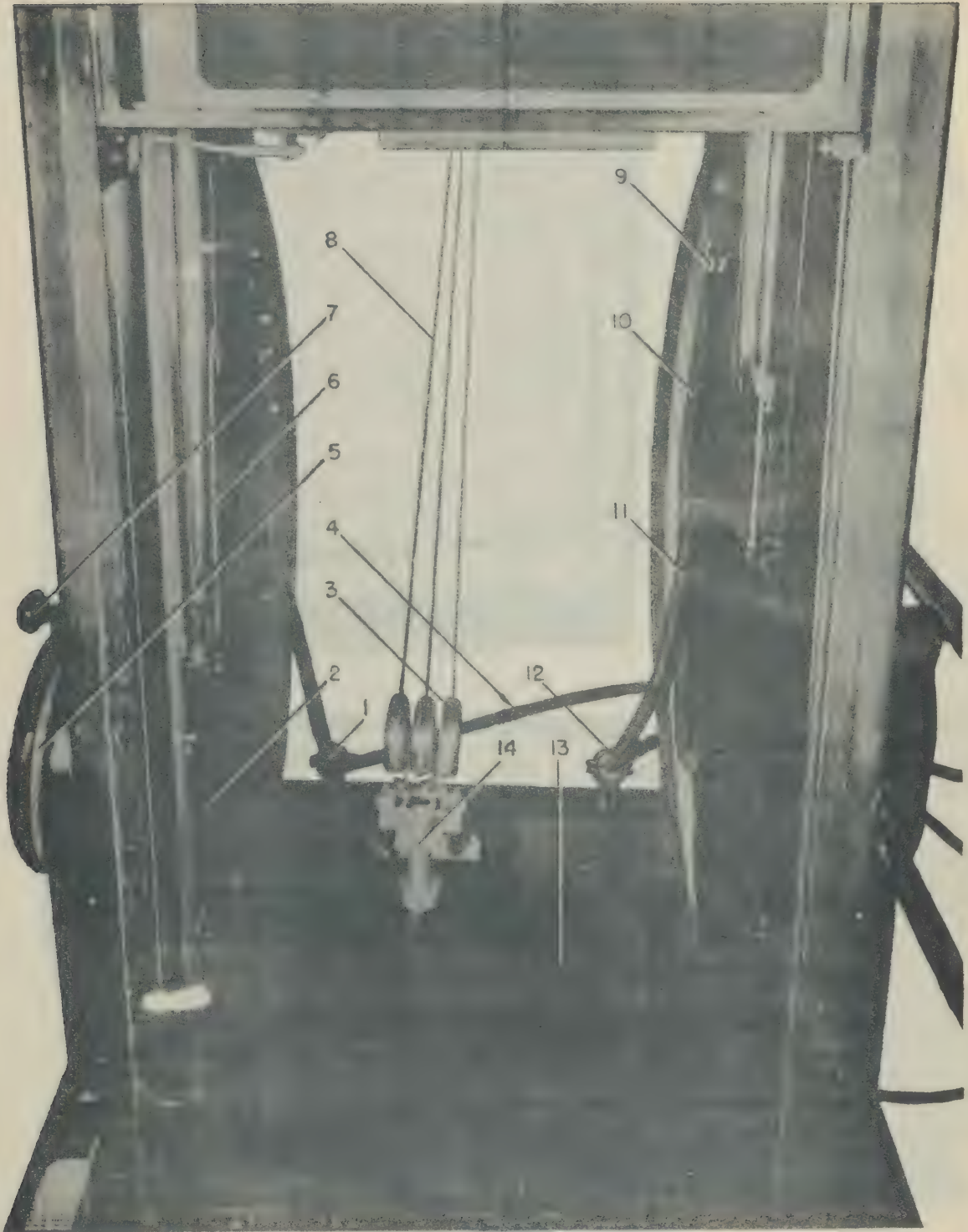


FIG. C-5652

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

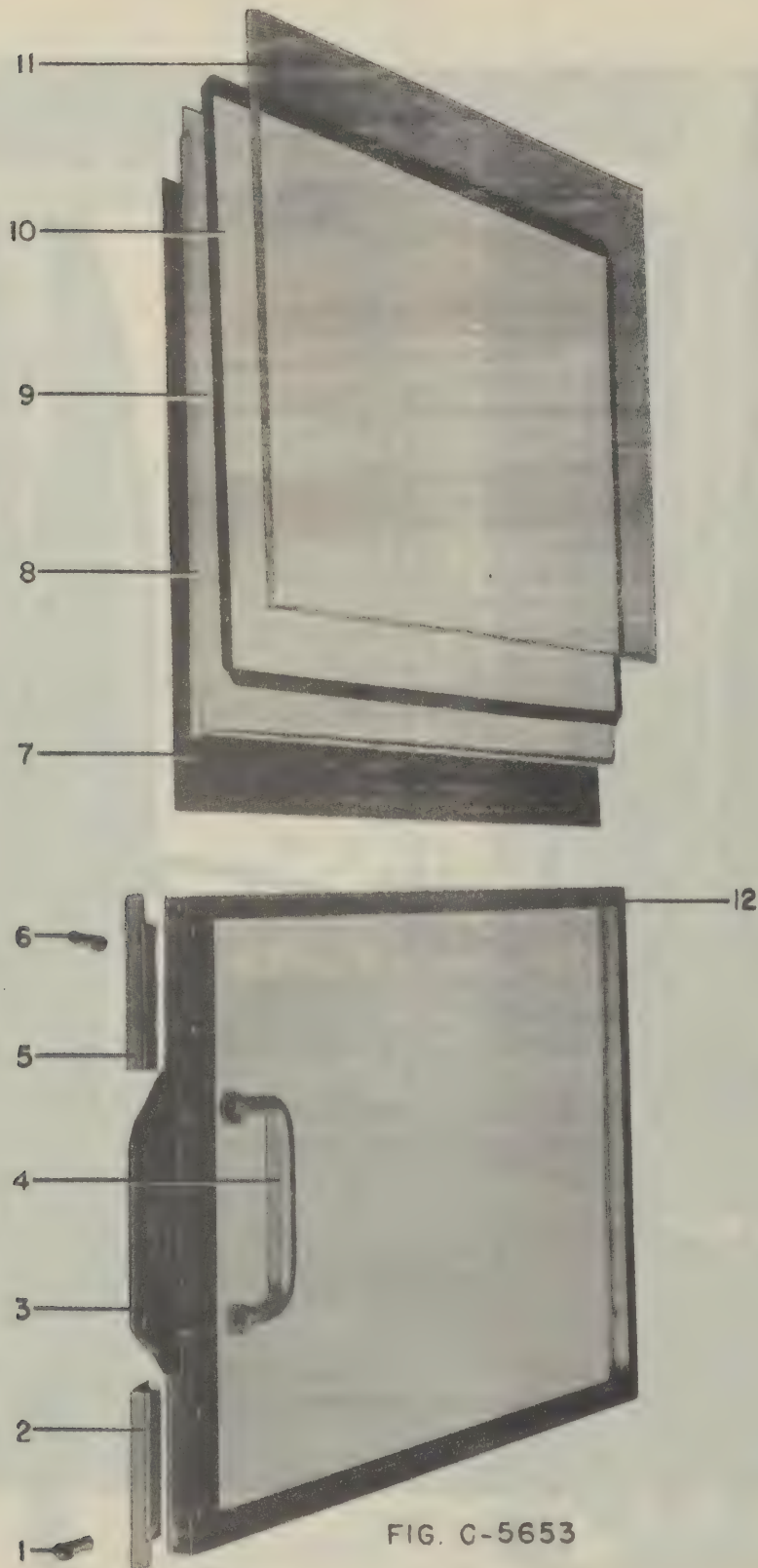


FIG. C-5653

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

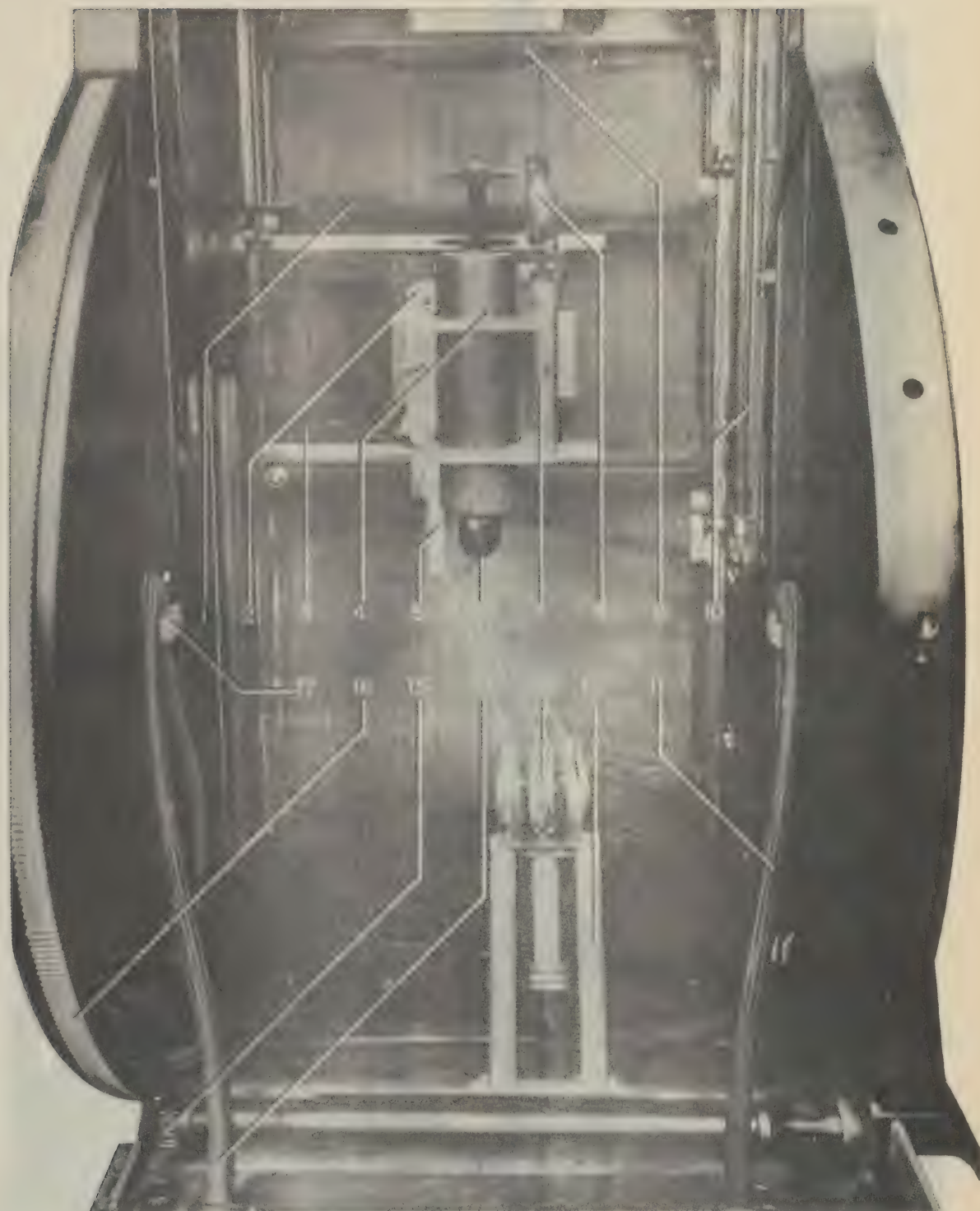


FIG C-5654

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

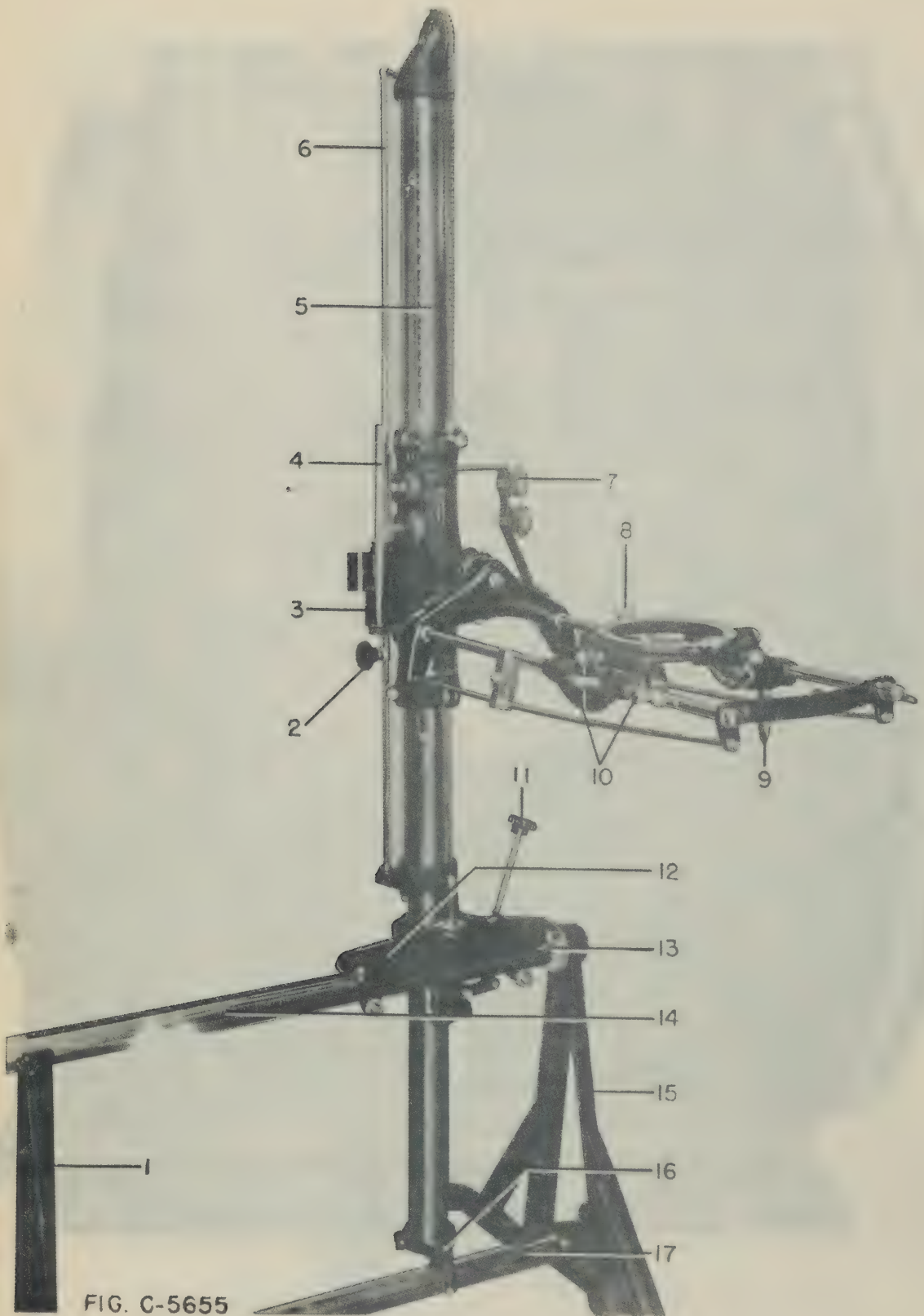
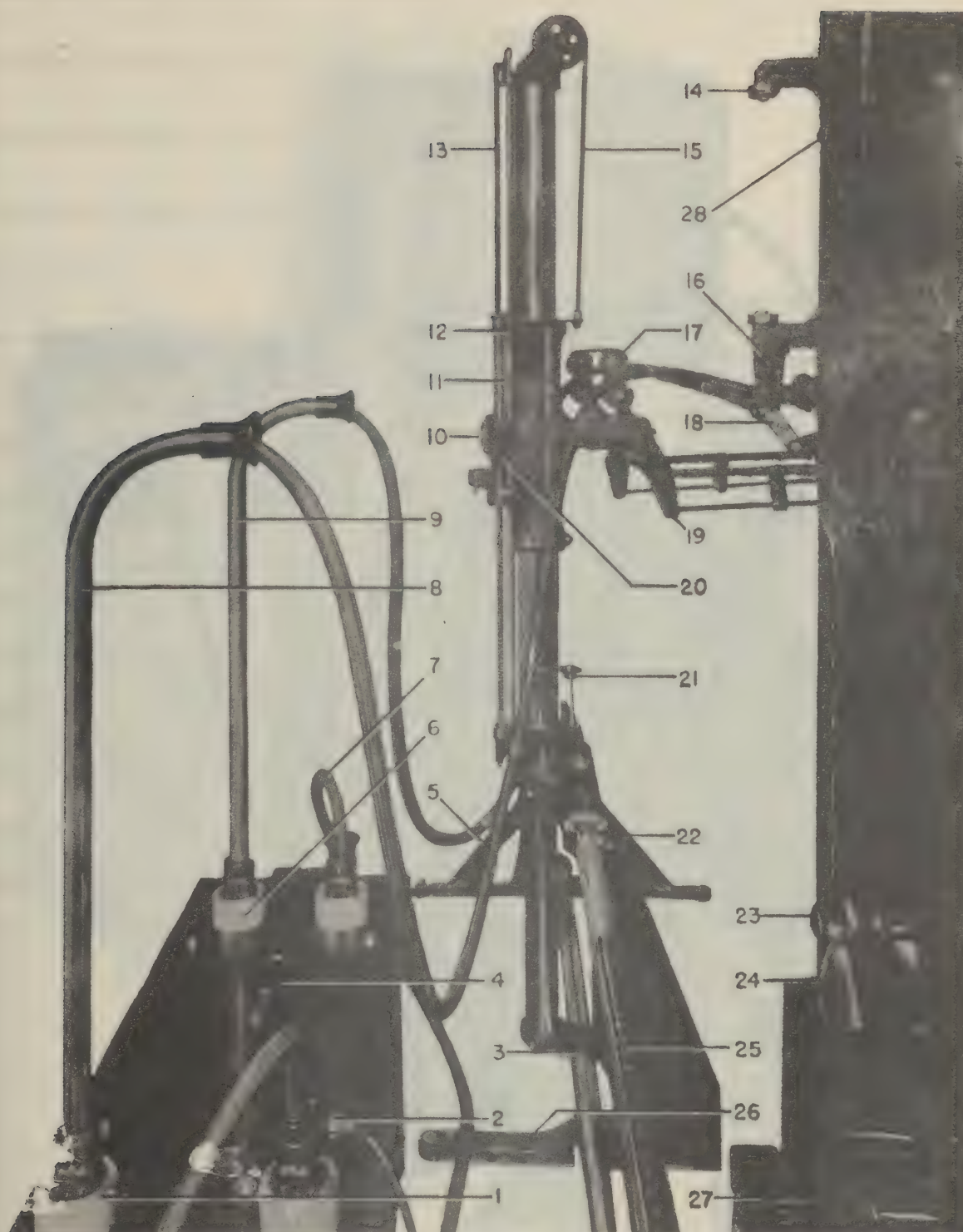


FIG. C-5655

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)



SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

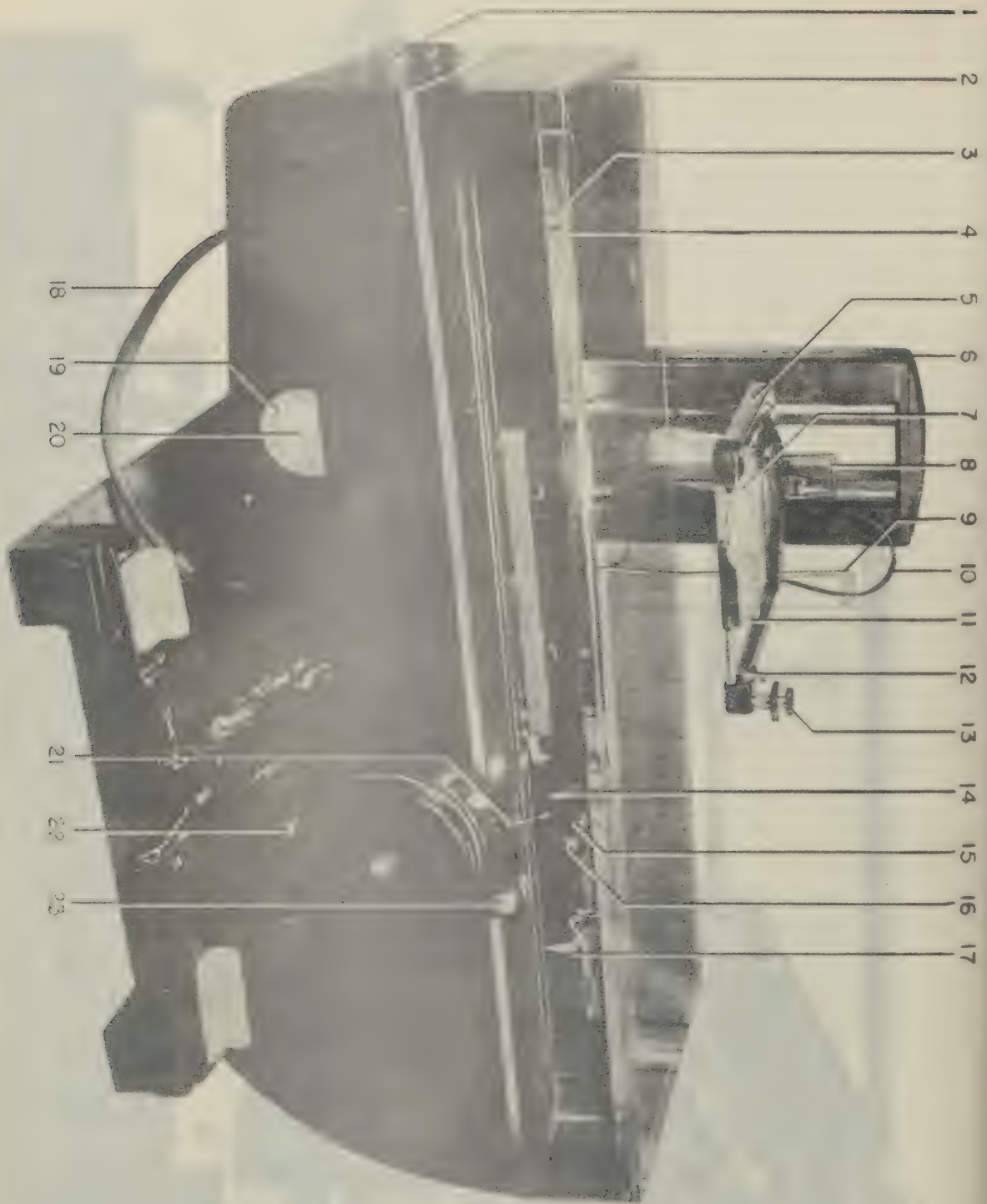
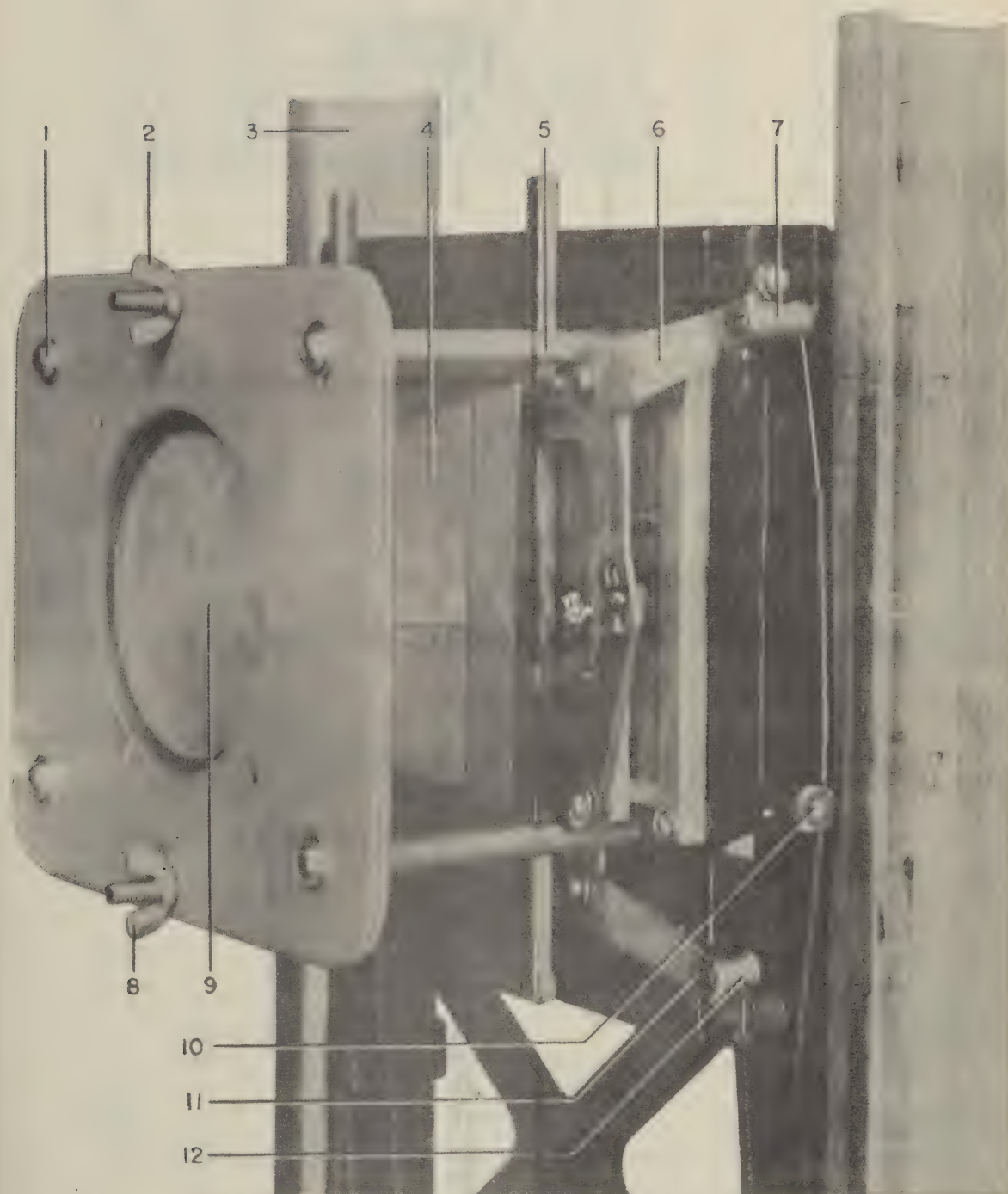
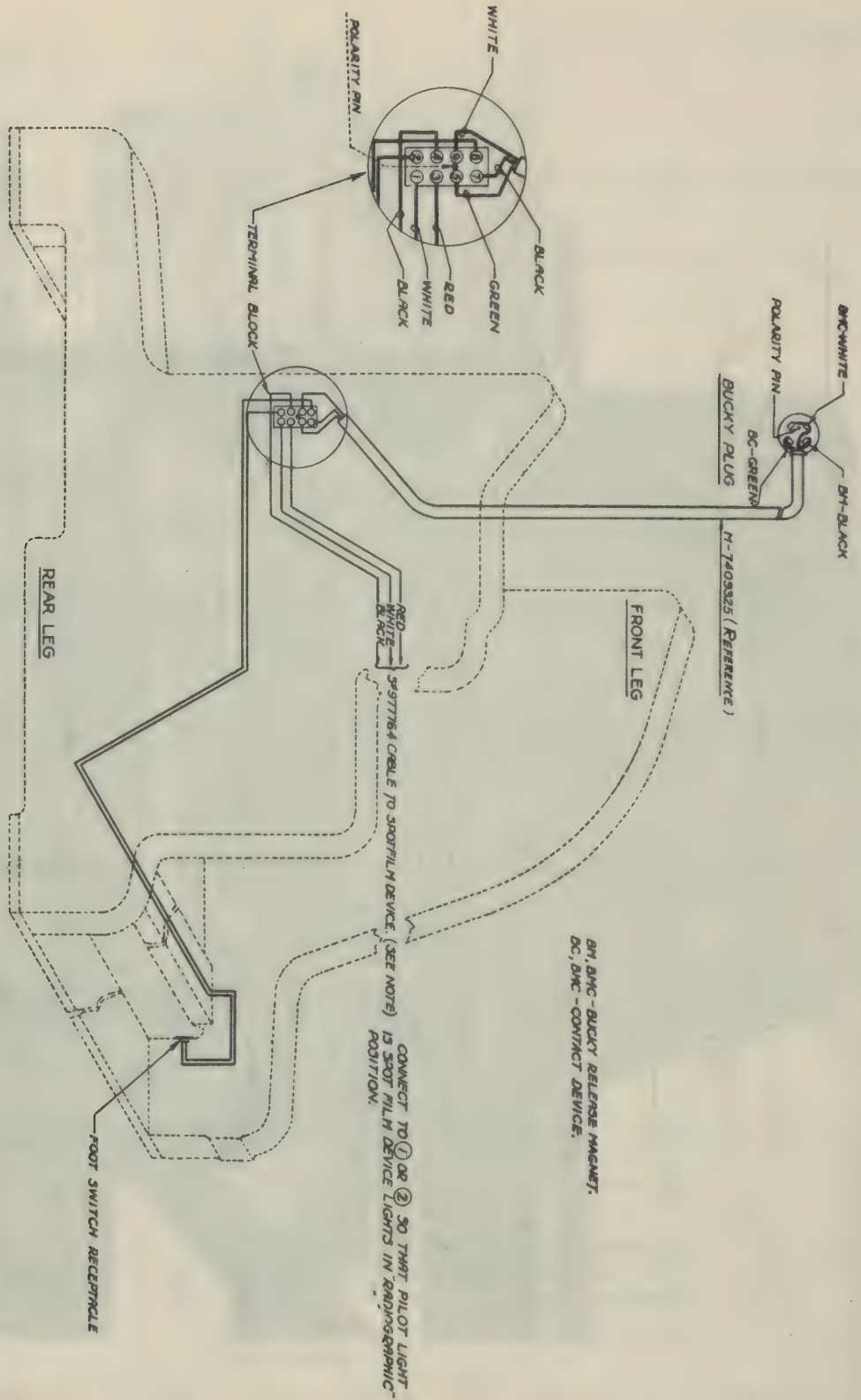


FIG. C-5657

SPECIAL HAND CRANK TABLE AND TUBESTAND (W)

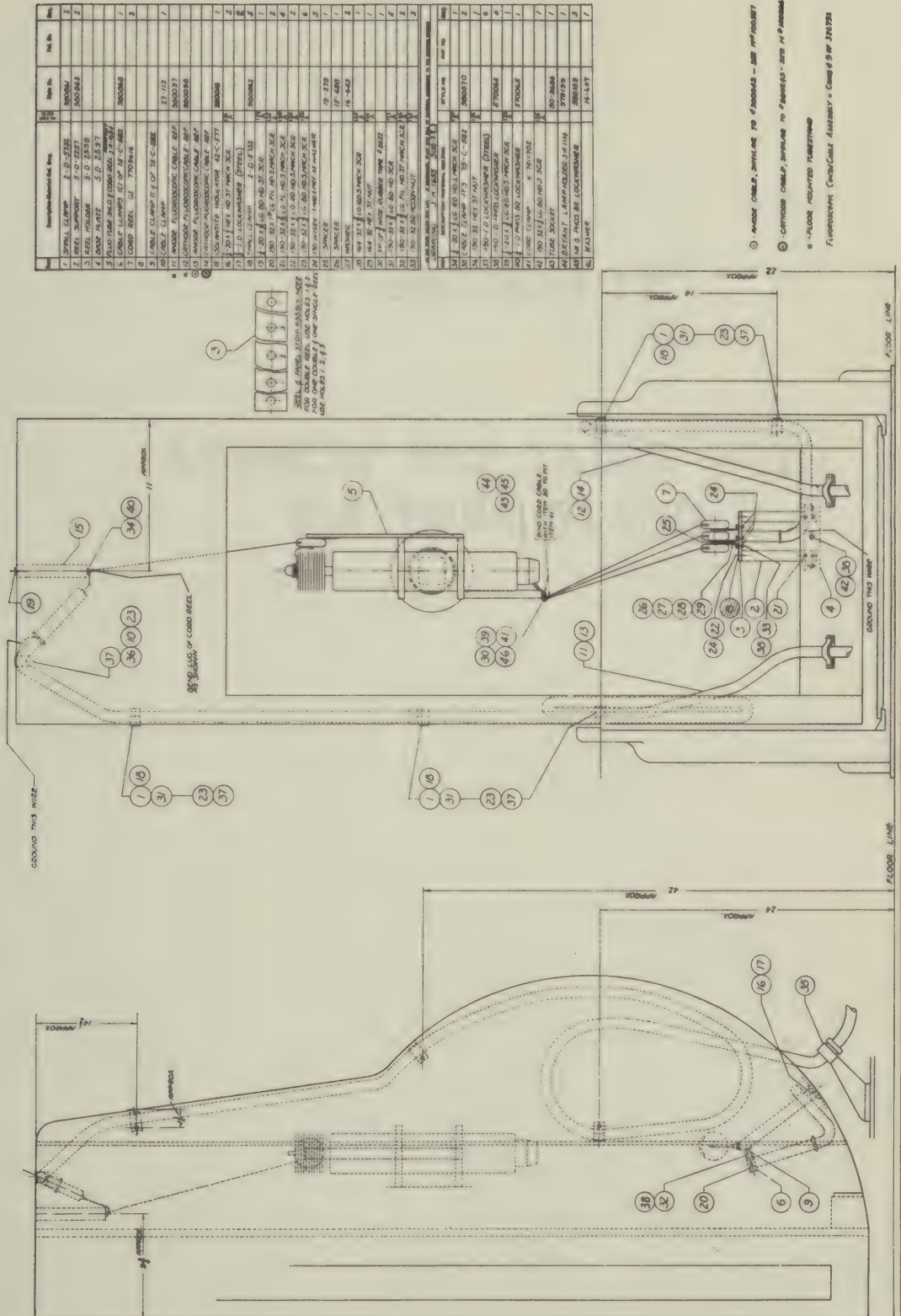


SPECIAL HAND CRANK AND TUBESTAND (W)



1. UNDER CARRIAGE WIRING DIAGRAM, DRAWING #7709755.

SPECIAL HAND CRANK AND TUBESTAND (W)



SECTION LI

KELEKET W-2 TABLE WITH 6-A TUBE STAND

SECTION 11

RELENT W-2 TABLE WITH
B-A TUBE STAND

KELEKET W-2 TABLE WITH 6-A TUBE STAND

DESCRIPTION - The W-2 Table is designed for Fluoroscopic and Radiographic procedure. The hand operated model employs a self-locking clutch which instantly locks the table when the operator stops turning the hand wheel. All moving parts are ball bearing; are counter-balanced for all table positions; and are provided with positive acting individual locks. The table is elevated by means of a geared quadrant driven by the hand crank. Complete protection from the gear is provided by means of a metal guard. The fluoroscopic shutter assembly and tube mounting is counter-balanced; it moves longitudinally along the table and has transverse travel across the table with positive locks for both motions. The Bucky Diaphragm is weight counter-balanced and the bucky cable is continuous (no reels) the slack being taken up as bucky moves along table by special spring and pulley device enclosed in metal guard. Shutter controls for fluoroscopy are mounted on screen frame. Table top has heavy metal trim with notched holes for attaching accessory devices. The table may be tilted from Trendelenberg through horizontal to the vertical position. Fluoroscopic screen arm is spring counter-balanced for horizontal position; the counter-balancing can be released for vertical position. The 6-A Tube Stand is mounted on two heavy side rails supported by end castings and braced in the middle by center support casting. The tube stand is provided with magnetically released vertical stereoshift and shockproof cable supporting brackets. It has a horizontal stereoshift spacer and lateral stereoshift on tube arm.

UNPACKING AND HANDLING - It is important in unpacking the table and tube stand so as not to damage any of the parts. Where the interior of a crate is hidden by weather-proofed paper wrapping, carefully tear a hole in paper if possible so as to note how the interior is packed before applying pinch-bars or other opening tools. In unpacking, check all parts carefully for possible damage and examine the packing material for small parts that might be overlooked. Some small parts are placed in cotton bags which are tied to large parts of the assembly.

The following pieces contain the W-2 Table and the 6-A Tube Stand.

1 - Wooden crate containing the W-2 Table less Fluoroscopic guard, one lead counter-weight, fluoroscopic screen and supporting arm and shockproof cables.

1 - Wooden box containing: Metal fluoroscopic guard with shockproof cables attached; panels for fluoroscopic guard; guard for gear segment; fluoroscopic screen; screen supporting arm with spring counter-balance swivel mounting; anatomical centimeter calipers; footswitch; footrest; shoulder supports; compression device; control interconnecting cable; main line cable; X-ray tube shockproof cables.

1 - Wooden crate containing vertical member for 6-A tube stand with stereoshift and cable clamps attached; set of two rails for tube stand.

1 - Wooden box containing parts for 6-A tube stand, including: set of end castings for supporting the rails; center leg support; tube carriage; ray line indicator; tie rod; spacer rod; set of three aluminum filters; 7-T cone; and extension cone.

2 - Wooden boxes containing lead counter-weights.

2 - Cartons containing X-ray tubes.

ASSEMBLY OF TABLE - The table should be located in the position it is to occupy. Remove the blocking and clamps that keep the Bucky and the fluoroscopic shutter and tube mounting plate from motion along table during shipment. The counter-balance weight for the fluoroscopic assembly should be installed. It consists of a long rectangular lead weight with a hole running through it centrally and with chains attached to each end. On the lower edge of the table will be seen a long rectangular steel bar bolted at each end to the table top assembly. The lead weight rides on ball bearing rollers on this bar. Two men will be required for the assembly of the weight, one should hold the weight horizontally and the other slide the bar through

KELEKET W-2 TABLE WITH 6-A TUBE STAND

the weight so that it rides on the rollers. The weight and one end of the rod should be held by one man while the other takes the other end of rod and moving in line with table, bolts his end to table. The weight is then shifted to other end and rod bolted in place. Loosen the pulleys over which the chain is to be placed and install chain, finally tightening pulleys. Turnbuckle adjustment should not be too tight. Now test motion of bucky and fluoroscopic assembly mounting plate and the clamps to make sure they are in adjustment. Note whether the bucky cable take-up device and metal guard are in order.

When the shockproof shield is assembled to the table, remove the cover plates from the rear of the shield. Two men are required to put the shield in place. Lift it high enough so that the forward offset of the shield on the side near the gear segment clears the highest point of the segment gear. The bolt holes through which the assembly bolts are passed should be matched on the shield and table. Nails or something similar engaged in these holes will keep the shield in place until the bolts are properly placed. After the bolts are inserted and tightened, the gear cover plate should be put on.

The fluoroscopic tube should now be attached to the tube mounting cone and the wires from the reels attached to the cable ends should be installed on tube. Remove bakelite table top by removing mounting screws. (Do not burr screw heads.) The fluoroscopic support arm may now be bolted to the fluoroscopic assembly supporting plate which rides under the table. The bolts for mounting this support arm are in place in the plate for shipment and are to be removed and used to mount the supporting arm. The small metal cover plate on the rear side of this arm should be removed until the shutter control wires have been installed. Next, remove the screw and small plate on the end of the short shaft to which the yoke of fluoroscopic screen frame is mounted and insert the shaft into the hole in the yoke, then replace the plate and screw. The two spring cables containing the wires for operating the shutters should be inserted through the supporting arm and clamped in place by the clamps found under the small cover plate. These cables should be brought down to the shutter assembly for connection to the shutters. One cable has end painted red, as is the clamp for holding the wire from this cable. Close the shutters and place control knobs on screen in closed position and tighten set screw on wires. Move control knobs back and forth to make sure the shutters move freely from open to closed position. After installing shutter controls, the motion of Bucky grid should be checked before putting table top back on table. Cock the bucky and trip to see if grid moves properly. Replace table top.

GROUNDING - The table should be grounded to a water pipe ground by means of the ground clamp. It is exceedingly important that a good ground be established to prevent static charges being built up in the table or the bucky resulting in possible damage.

ADJUSTOR CLUTCH - This clutch is adjusted before leaving factory, if for any reason it should need adjustment the attached sketch will explain it. There is a certain amount of *lost motion* in the hand wheel which is *necessary*. **DO NOT TRY TO TAKE THIS OUT.** (Refer to the drawing.) By turning the hand wheel in either direction this lost motion allows adjusting screws "A" and "A-1" to strike lock fingers "B", releasing lock rollers "D" allowing table to move. When hand wheel is stopped, lock spring "J" automatically pushes lock roller "D" into locking position.

Lock spring "J" has enough tension to keep the weight of the crank handle from unlocking the clutch.

To adjust screws "A" and "A-1" run screws out so they do not touch lock fingers "B". Put load on foot end of table and turn in the direction to lift it, then run

KELEKET W-2 TABLE WITH 6-A TUBE STAND

screws "A" and "A-1" in until hand wheel turns freely and tightens set screw "C".

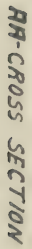
Do the same with load on head end of table and adjust screw "A-1". Be sure not to run adjusting screws "A" and "A-1" in too far as it will cause lock roller "D" to touch opposite roller which will cause the clutch to bind. The whole clutch assembly should be well greased at all times. It is the opinion of the factory that Keystone grease is the best for this purpose.

TUBE STAND ASSEMBLY - The two end castings for the rails should be placed at rear of the table and the rails bolted to them. The center support casting should next be bolted to the rails and adjustment made of the floating base so that it is against the floor. Now remove the eccentric roller on the tube column base. This roller is near the top of this casting and is used to keep the tube column from being lifted from the rails once it is in place. It rides on the lower side of the top rail. With this roller removed the tube column can be placed on the two rails. Because of its weight, it must be handled carefully. Remove shipping rod from top of vertical tubing which holds weight in place during shipment. Holding the tube stand in vertical position bring it up to the rails. Now tilt the tube column backward slightly placing it on the lower rail first. Bring the tube column upright slowly, raising it at same time, until top rollers are on top rail. Care must be exercised so as not to mar the rail as this will cause interference with free motion along rails. Replace the eccentric roller and rotate its adjusting screw until the roller just touches bottom of the top rail. Move stand along rails to make sure that eccentric roller does not bind at any position.

LEVELING - Both the tube stand and the table must be carefully leveled. After placing stand at proper position by table it is tied to table by means of bolt and spacer nuts and hole on table base castings.

TUBE ARM - Next install tube arm. This is accomplished in much the same manner as installing the Fluoroscopic Screen. A short shaft on vertical rider of tube column supports the tube arm. Remove the screw and small plate on end of shaft and insert into tube arm mounting casting. Replace plate and screw. The tube arm should be handled carefully so as not to damage the end of steel tape on ray-line indicator as it projects slightly beyond lower edge of framework on tube arm. Next mount tube also support cables by means of clamps at top of tube column.

CLUTCH ASSEMBLY



SECTION LII

PHOTO-ROENTGENOGRAPHY

SECTION 111

PHOTO-COPYING PERMITTED

PHOTO-ROENTGENOGRAPHY

PHOTO-ROENTGENOGRAPHY - Defined, it is the photography of a fluorescent image accomplished through a combination of radiographic and photographic equipment. A diagnostic X-ray apparatus having a capacity of at least 200 M.A. plus a Photo-Roentgen unit is necessary to do Photo-Roentgenography. A Photo-Roentgen unit is essentially a camera assembly with a lens at one end and a 14 x 17 inch fluorescent screen at the other. Both lens and screen are designed especially for Photo-Roentgenography.

The main purpose of this unit is to decrease the individual film cost per patient, particularly in chest examinations. Being able to radiograph a chest by means of the devices explained above, the resultant film or radiograph is 4 x 5 inches. From the standpoint of economy this means that in comparison to the standard 14 x 17 inch size, the cost is reduced to one tenth, or in other words, with a Photo-Roentgen unit ten patients may be examined for the same cost as one using the 14 x 17 inch film. Chemical costs are of the same proportion.

The first announcement of this unit was made in September 1939 and on or about October 1, 1940, the National Defense Program specified that these units be placed in each Army induction center for the examination of selected trainees.

The two outstanding advantages of this type of chest examination are: first, economy and second, rapidity of examinations. (Some induction centers have been able to radiograph as many as 800 selectees in an average day.)

For single examinations the 4 x 5 inch film is used. However, stereoscopic examinations may be made, produced in the conventional stereoscopic manner, on a single 4 x 10 inch film. This procedure provides a perception of depth in the same manner as ordinary stereoscopy, using the larger size film.

The following data covers the directions for installing and operating the G.E. Photo-Roentgenographic unit.

DIRECTIONS FOR INSTALLING AND OPERATING THE G.E. PHOTO-ROENTGENOGRAPHIC UNIT - The General Electric Photo-Roentgenographic Unit is shipped from the factory with the hood Fig. 1, the camera Fig. 3 and the base Fig. 2, removed.

Care should be exercised in unpacking the various parts, particularly the camera and the fluoroscopic screen, to avoid damaging them.

ASSEMBLY - Place the upright assembly on the base Fig. 2, and bolt it in place with the four bolts, Fig. 4, Illustration No. 1.

Fasten the castings Fig. 6 and Fig. 20 to the hood Fig. 1 as shown in View "A" using the screws provided. Set screws will be found in the mounting holes on the hood.

The hood shall now be placed in the vertical carriage in the following manner. Referring to View "A", Illustration No. 1, place the rounded portion of the casting Fig. 6, on the horizontal rod Fig. 5, of the vertical carriage.

Holding the hood in place from the front, swing the top of the hood into position and lock it in place with the thumb screw Fig. 9, on the top rod of the carriage.

The camera Fig. 3, is installed by placing it in the adapter on the end of the hood and locking it in position by the thumb screw Fig. 8.

PHOTO-ROENTGENOGRAPHY

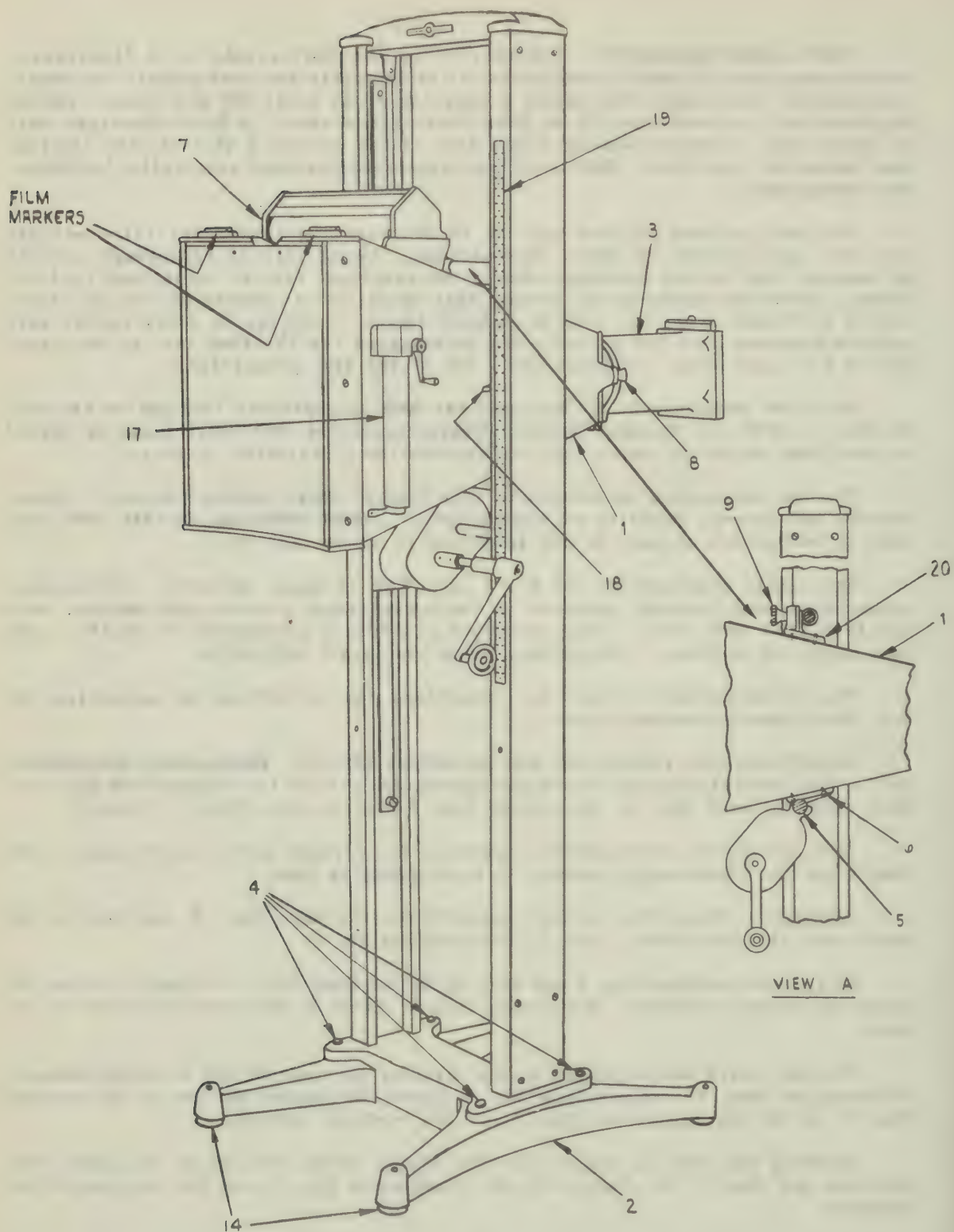


ILLUSTRATION 1

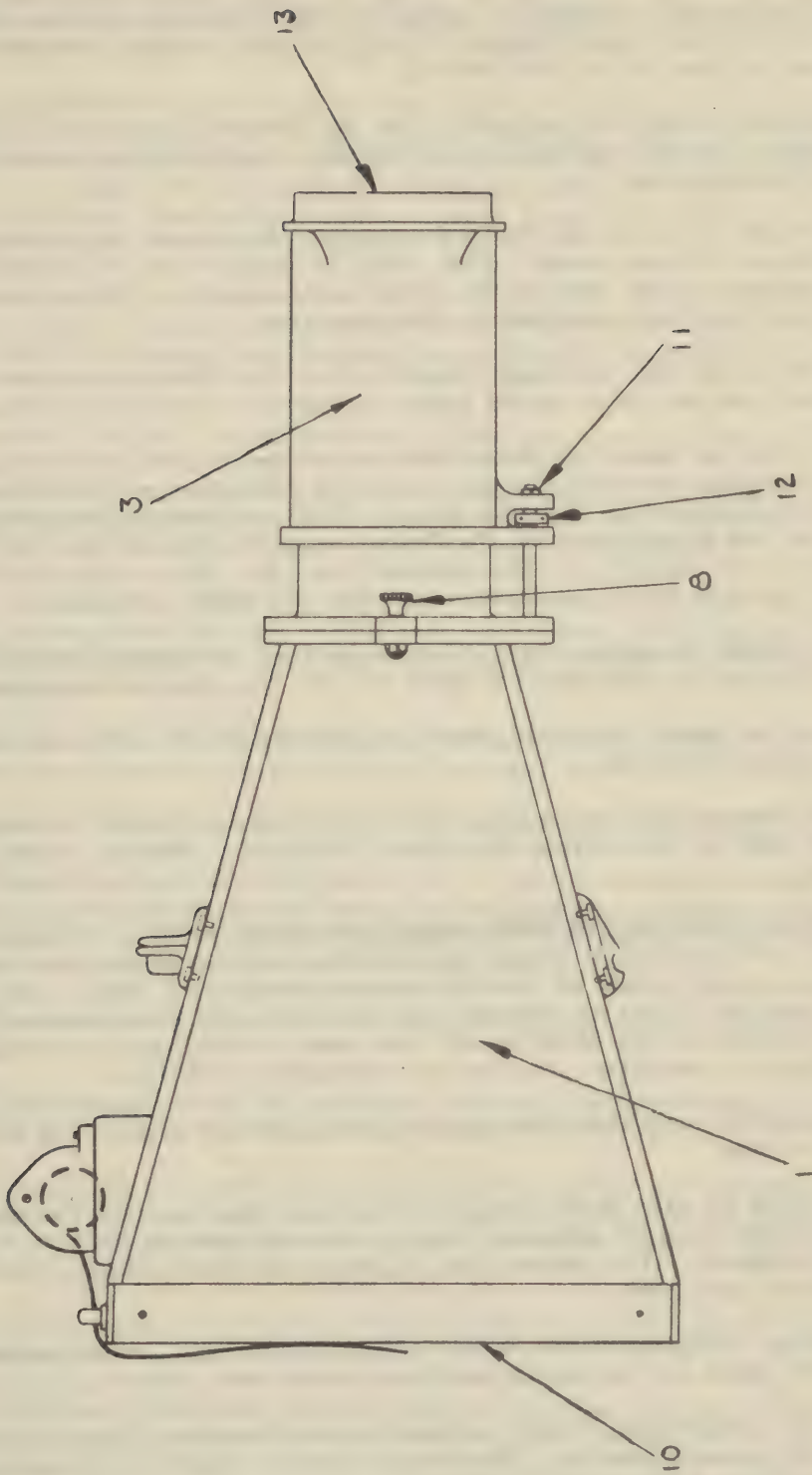


ILLUSTRATION 2

PHOTO-ROENTGENOGRAPHY

The base of the stand is equipped with four leveling pads Fig. 14, Illustration No. 1, adjustable by means of screws through the base casting. When the stand is placed in the position in which it will be used, adjust the pads, so that it is level and to give it a firm footing.

The height indicator scale Fig. 19, is fastened to a metal track which in turn is mounted on the vertical column making it possible to slide it up or down for correct positioning.

The height scale on the Photo-Roentgenoscope is set to correspond with the height scale on the tube stand. This shall be done in the following manner. Set the arrow marked "table top" of the index scale opposite "25" on the tube column scale and lock the tube carriage in this position.

With the x-ray tube carriage turned to face the Photo-Roentgenoscope, measure the distance from the floor to the center on target of the x-ray tube.

Then raise or lower the Photo-Roentgenoscope so that the distance from the center of the Photo-Roentgenoscope screen to the floor will be the same as the distance just measured at the tube stand. With the Photo-Roentgenoscope in this position, set the height scale on the Photo-Roentgenoscope so that "25" on the scale will be directly opposite to the pointer Fig. 18. This will accurately center the x-ray tube and Photo-Roentgenoscope for all other settings.

If the paper dispenser Fig. 7, is a part of the installation, the housing shall be fastened to the hood by means of the four screws furnished.

The roll of paper furnished shall be inserted in the slots of the paper dispenser on top of the hood.

If the compression device Fig. 17, is to be used, it shall be fastened to the side of the hood as shown using the screws furnished. Mounting holes are provided in the hood.

SYSTEM OF FOCUSING THE PHOTO-ROENTGENOGRAPHIC UNIT - In testing the energizing unit care should be exercised that the tube is turned away from the foot of the fluorescent screen of the Photo-Roentgenographic unit. Heavy continued exposures with no filtering medium such as a patient, for example, may cause a sufficient amount of lag which would take some little time to dissipate itself. With a patient in position it is of no consequence whatever.

Accompanying each Photo-Roentgenographic Unit is a piece of wire mesh 14 x 17 inches in size.

This piece of wire mesh should be fixed to the front of the unit, Fig. 10, Illustration No. 2, with adhesive tape or Scotch tape so that it will not move during the exposure. This means that it has to be fixed firmly both at the top, the bottom and each side.

The actual focusing of the camera to the fluorescent screen is done by photographing the image of the above mentioned wire mesh, using an x-ray exposure.

Under no condition attempt to develop the focusing film by sight in order to obtain the correct density. The technic itself should be changed so that full development of the film can be utilized.

PHOTO-ROENTGENOGRAPHY

The slightly decreased density toward the edges of the film likewise is of no consequence. When the energy is increased to the point that actual radiographs are made, this difference in density means nothing.

The suggested starting procedure for a Photo-Roentgen film of the wire mesh is 100 ma.s., 40" distance, 30 kv.p. It is suggested that one film be taken in this manner and fully developed. Should the density be too light, an increase to 32 kv.p., is recommended and a second exposure made. In other words, start at 100 ma.s., 30 kv.p., increasing 2 kv.p., at a time, if necessary, until proper density is obtained with full development.

The first step in checking the focus of the unit is obviously to take one film with the camera focused as received from the factory. Place a lead number 1 on the wire mesh before making the exposure and number subsequent exposures consecutively.

This test film will show whether or not the camera is properly focused.

If this first test exposure is of the right quality from the standpoint of density and the exposed area on the film shows that the camera is not in focus as compared to the attached sample film, proceed as follows:

Loosen the lock nut Fig. 11, and move the focusing nut Fig. 12, 180 degrees clockwise. After this is done, again make sure that the lock nut Fig. 11, is tight and another exposure of the wire mesh should be made in this position, with a lead number 2 on the mesh.

Again loosen the lock nut and move the adjusting nut Fig. 12, in the opposite direction (counterclockwise) 360 degrees, and lock in position.

An exposure should be made with this adjustment and numbered three.

Three exposures have now been made; No. 1 as the camera was adjusted in the factory, No. 2 with the adjusting nut moved 180 degrees clockwise from the first position, and No. 3 with the adjusting nut moved 180 degrees back from the first position, or 360 degrees back from the second position.

One of the last two films should present better detail sharpness than the first film.

Choose the one which is the sharpest in detail by comparison, and again move the adjusting nut another 180 degrees in the same direction.

You are now moving in the direction of steadily increased sharpness of detail. It is recommended that you make two extra exposures going by the point of maximum sharpness and then coming back to the proper position. Number each exposure and keep a written record of the setting for each.

Be positive in each instance as the focusing nut is changed that the lock nut is tightened before each exposure.

After the camera has been properly focused and the lock nut tightened, there should be no difficulty in maintaining focus.

TECHNICAL PROCEDURE-DEVELOPING SOLUTION - Be sure that the developer is fresh and at proper temperature. The technical procedure outlined herein is based

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on the use of Eastman Blue Brand film or its equivalent, and either Kodak or Super Mix developer. To obtain best results, it is necessary to use a developing time based upon 6 minutes at 65 degrees. The following developing schedule is recommended:

- a. First Period of Life
 - 65 degrees - 6 minutes
 - 67 degrees - 5 minutes
 - 70 degrees - 4 minutes
- b. Second Period of Developer Life
 - 65 degrees - 7½ minutes
 - 67 degrees - 6 minutes
 - 70 degrees - 5 minutes
- c. Third Period of Developer Life
 - 65 degrees - 8½ minutes
 - 67 degrees - 7 minutes
 - 70 degrees - 6 minutes

The life of the developer has been divided into the three periods corresponding to divisions of the total developer life as represented by twenty-five 14 by 17 films per gallon of solution. Under average conditions, the life of the developer may be divided into three parts corresponding to divisions of the total developer life as represented by two hundred 4 by 5 films per gallon of solution. After approximately seventy-five 4 by 5 films per gallon of solution have been developed, it is necessary to increase the developing time. The developing time again must be increased after one hundred fifty 4 by 5 films per gallon of solution have been developed. After two hundred 4 by 5 films have been developed per gallon of solution, it should be replaced.

FILM MARKER - Two film markers are furnished for the purpose of marking the film with such information as may be desired or necessary. This information may be typed or written on a piece of bond paper. Each marker frame is stamped on one of its two sides with the word "front". When placing this marker in the receptacle at the top of the fluoroscopic screen, the word "front" should be toward the x-ray tube. The paper tab should be inserted in the marker frame with the side which has been written on toward the camera. When an exposure of the chest is made, the fluorescent light from the screen is sufficiently strong to be transmitted through the paper but not through the printed information on it. Thus, at the time the exposure is made, the camera will record the information which has been placed upon the paper tab. It will be found advantageous to place a piece of carbon paper, reversed, beneath the tab when the information is placed on it, either with the typewriter or preferably with a soft lead pencil. The letters of the written or printed information will be larger and more opaque to the fluorescent light when backed up with carbon paper. Thus the information will be more legible.

MACHINE FACTORS - The actual technic recommended for the production of Photo-Roentgenograms obviously depends upon the type and capacity of the energizing equipment. Two technic charts are appended, one based on 200 ma. operation, the other on 400 ma. operation. These technics should be considered as starting points only, corrections to be made as needed to correct for differences in energizing unit characteristics.

The technics presented are based on a procedure that requires adjustment of the tube filament to produce 200 ma. (or 400 ma.) at 80 kv.p. and maintaining that value of filament current for all technics even tho the milliamperage falls below 200 ma. (or 400 ma.) at voltages less than 80 kv.p. The 200 ma. or 400 ma. setting

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usually will be obtained by establishing the base value at 50 ma. and applying the filament increment as given in the charts accompanying the tube. In any case follow the procedure recommended for the tube actually used.

ESTABLISHING THE TECHNIC - Obtain a patient of average size, measuring approximately 20 to 22 cm. at full expiration. Chest measurement should always be at full expiration for increased accuracy. The measurement should be made through the lower margin of the scapula with the stick horizontal. Refer to the accompanying technic chart for the values to be used in the technic exposure.

TECHNIC CHART

FOR PHOTO-ROENTGENOGRAPHY USING EASTMAN BLUE-BRAND FILMS OR EQUIVALENT

200 Ma. 40 INCH DISTANCE

THICKNESS IN CM.	KV.P.	TIME	MA.S.
14	60	2/10	40
15	62	2/10	40
16	64	2/10	40
17	66	2/10	40
18	68	2/10	40
19	70	2/10	40
20	72	2/10	40
21	74	2/10	40
22	76	2/10	40
23	78	2/10	40
24	80	2/10	60
25	70	3/10	60
26	72	3/10	60
27	74	3/10	60
28	76	3/10	60
29	78	3/10	60
30	80	3/10	60

For Female Patients add 4 kv.p.

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DIRECTIONS FOR INSTALLING THE G.E. 4 x 10 FILM SHIFTER FOR THE PHOTO-ROENTGENOSCOPE

GENERAL - The film shifter is shipped from the factory completely assembled except for the electrical wiring. Since most tube stand stereo shifters shift upward, the film shifter is arranged at the factory to operate in this manner. If the tube stand stereo shifter used in conjunction with the film shifter shifts downward, the film shifter must be reversed, or a pseudo-stereo effect will be obtained when the film is viewed in the ortho-stereoscope. For convenience, this should be done before installing the unit on the Photo-Roentgenoscope.

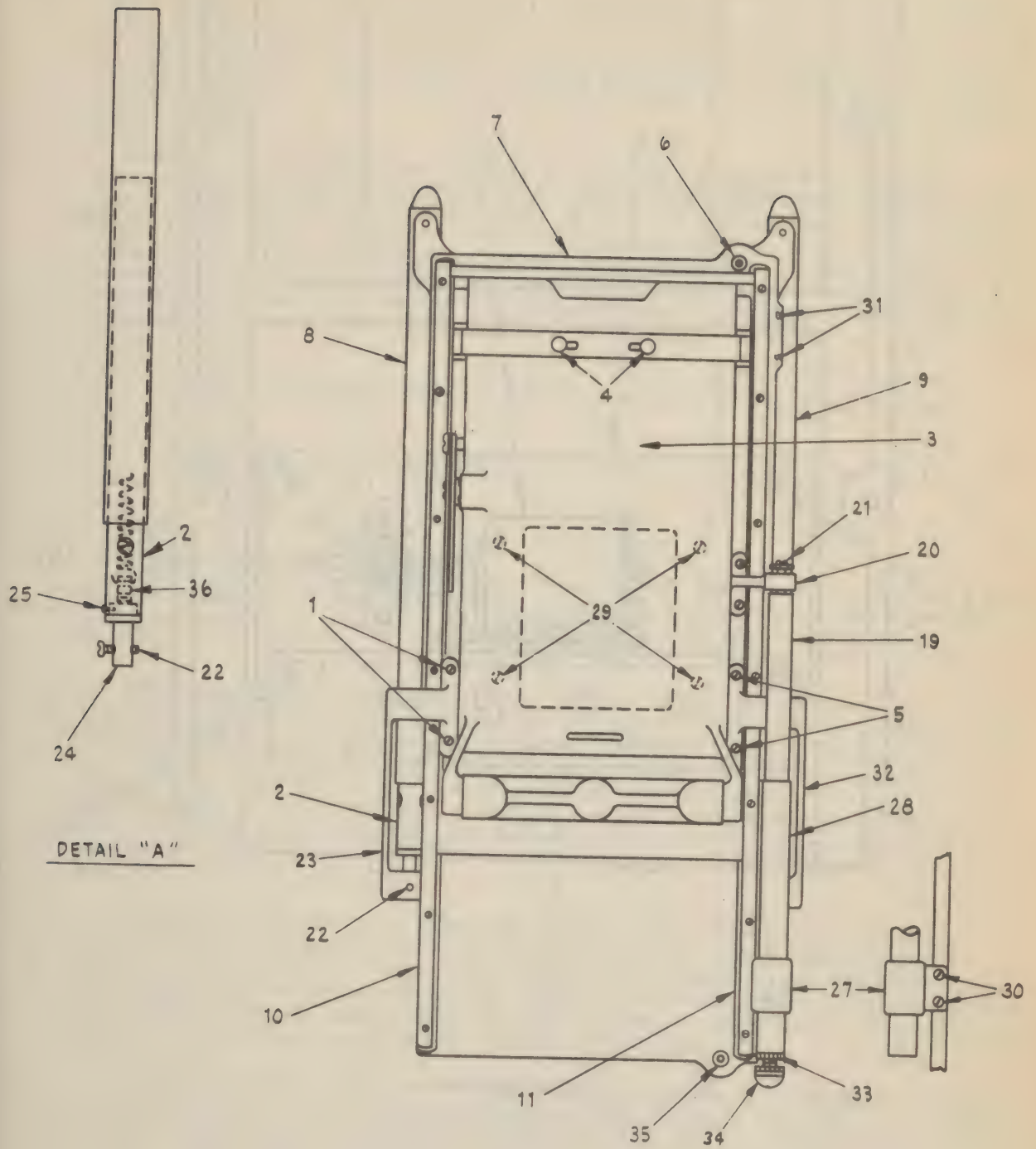
INSTALLING THE FILM SHIFTER ON THE PHOTO-ROENTGENOSCOPE - Place the film shifter assembly on a bench or table with suitable padding material beneath it to prevent scratching the finished surfaces. Rest the assembly on the metal housing so that the Film Holder Carriage is facing upwards. Referring to Illustration No. 3, remove the two screws Fig. 1, which fasten the spring sleeve Fig. 2, to the carriage Fig. 3. Remove the spring sleeve from the opposite side of the carriage by taking out the two screws Fig. 5. *CAUTION: Be sure to hold the castings Fig. 23 and Fig. 32 when removing the screws Fig. 1 and Fig. 5.* Next remove the bakelite stop Fig. 6, from the frame Fig. 7.

Turn the Film Holder Assembly over so that the metal housing is facing upward. Remove the film holder from the holder carriage Fig. 3, Illustration No. 3, by pressing the two knobs Fig. 4, together and opening the carriage. Remove the four screws which hold the housing in place and take off the housing. This gives access to the solenoid Fig. 12, and the plunger Fig. 15, Illustration No. 4, which releases the film holder carriage. Swing the spring casings Fig. 8 and Fig. 9, Illustration No. 3, away from the frame. Push the plunger Fig. 11, Illustration No. 4, into the solenoid coil Fig. 12, thereby disengaging the pin in the carriage and slide the carriage out of the tracks Fig. 10 and Fig. 11, Illustration No. 3, and place it aside temporarily.

If the Photo-Roentgenoscope is already equipped with a 4 x 5 film holder adapter, this must be removed by taking out the four machine screws that hold it in place. Slide the housing for the film shifter over the camera and place it as far back toward the hood as possible. With the conical ends of the spring casings Fig. 8 and Fig. 9 facing upward, place the frame of the film shifter up against the camera in the same manner as the 4 x 5 film holder. *CAUTION: Be sure the face of the camera housing is smooth and free from paint.* Fasten it to the camera with the four flat head screws Fig. 29, which are furnished. At this point of the installation, it is necessary to complete all Electrical Connections at the terminal board of the film shifter and test the electrical circuit.

HAND SWITCH - When a type S-1 (#4) Synchronous Timer is a part of the installation, a single button hand switch must be used for controlling the tube and film shifter, magnetic releases and a separate hand switch used for the timer as shown in Diagram No. 2. The two button "stereo-timer" hand switch can be used only in conjunction with the S-2 and S-3 Timers. If a tube stand stereo shifter is not a part of the installation, the connections for it shown in the wiring diagram can be disregarded.

ELECTRICAL CONNECTIONS - Observe the nameplate stamping on the Film Shifter to see that the voltage and frequency corresponds to that of the line on which it is to be used. Wiring between the tube stand magnetic release and the film shifter magnetic release must be provided by the customer. If this wiring is run in concealed conduit, the conductors should be #14 A.W.G. rubber covered wires. Two conductor #18 A.W.G. rubber covered cable can be used in the event conduit is not installed.



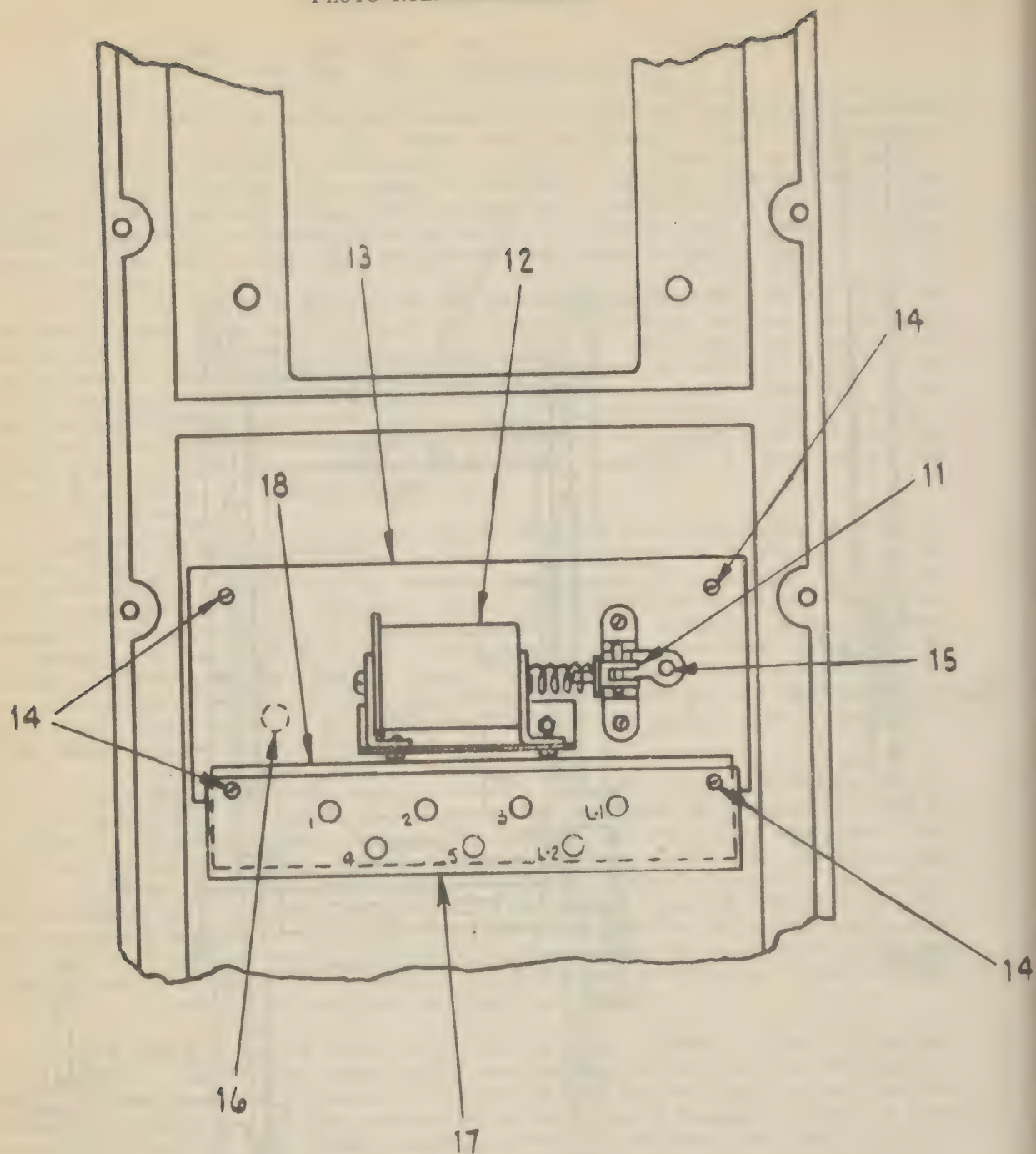


ILLUSTRATION 4

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When making a concealed wiring installation, a wall box with a single convenience outlet should be installed at the rear of the Photo-Roentgenoscope approximately 4 feet from the floor. The two #14 A.W.G. conductors can then be run in 1/2" conduit between the outlet and the control stand floor box. If concealed wiring is not used, a two conductor #18 A.W.G. rubber covered cable may be used between the control stand or the x-ray table floor box and the Film Holder Magnetic Release.

With a concealed wiring installation, a short piece of two conductor rubber covered cable equipped with a male plug, must be provided between the wall outlet and the magnetic release terminal board. Solder the two cord tips furnished to the leads in the cable and connect them to terminals "3" and "L-1" on the magnetic release terminal board. Fasten the cable to the film holder support by means of the cable clamp provided and insert the male plug in the convenience outlet on the wall. Connections at the other end of the concealed conduit are made in accordance with Diagrams No. 1 and No. 2. The wiring Diagram No. 2 will apply for any type of x-ray apparatus.

TESTING - With the housing removed from the Film Shifter, the following test should be made:

Connect an A.C. voltmeter (0-150V) across terminals "3" and "L-1" on the magnetic release terminal board.

Energize the control stand.

Press the "Stereo" hand switch button and note the voltmeter reading. This reading should be between 105 and 120 volts. If the reading of the voltmeter is above or below these limits, investigate to determine the reason and correct the difficulty.

With connections completed, guide the film holder carriage into the tracks Fig. 10 and Fig. 11 as shown, pressing the plunger into the solenoid so that the pin which engages the carriage is out of the way. *CAUTION: It is important that the pin be entirely out of the way to prevent tearing the felt light trap attached to the carriage.* Fasten the housing in place on the rear of the film shifter frame with the four screws which were previously removed. Bring the two spring casings Fig. 8 and Fig. 9 into position and fasten the brackets Fig. 23 and Fig. 32 to the carriage with the screws Fig. 1 and Fig. 5 respectively. Install the bakelite stop Fig. 6 at the top of the frame.

GENERAL OPERATION - The film holder should be in the carriage when the film shifter is operated. To operate the film shifter, push the carriage down until it reaches the stop catch. Set the x-ray tube for the first stereo-radiograph. Energize the control stand. Press the stereo hand switch. The x-ray tube and the film holder carriage should move upward. If the film shifter is set to shift downward, the action should be the reverse of the above.

ADJUSTMENTS - The speed of travel of the carriage Fig. 3 is adjustable by means of the air valve Fig. 34. This adjustment is quite critical and therefore requires careful manipulation. Adjustment should be made with the film holder in the carriage. When proper adjustment is attained the screw Fig. 34, should be locked in position with the nut Fig. 33. The carriage should travel fast enough to cover the full excursion and just touch the stop Fig. 35 or Fig. 6. The carriage must not bounce against the stop, or it will cause vibration. A few drops of oil should be placed on each spring sleeve and on the plunger Fig. 19. The washer on the plunger

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Fig. 19, should also have a few drops of oil placed on it to insure proper operation.

RE-FOCUSING THE CAMERA - All Photo-Roentgenographic Units are focused at the factory with a 4 x 5 film holder. When the film shifter is installed in place of the 4 x 5 film holder on the Photo-Roentgenographic Unit, it is necessary to re-focus the camera due to the added thickness of the film shifter. The camera must be moved approximately 3/8" toward the screen to compensate for this difference.

The Procedure for focusing is explained in detail in the directions for Operation supplied with the Photo-Roentgenographic Unit.

NOTE: If there is any tendency for the camera to bind when adjusting the focusing screw, this can be eliminated by lifting upwards on the rear of the camera housing. Do not force the focusing screw - use only the fingers in turning it.

REVERSING THE ACTION OF THE FILM SHIFTER - Refer to the first two paragraphs on General Instructions and Installing the Film Shifter and continue as follows:

Remove the film holder from the holder carriage Fig. 3, Illustration No. 1, by pressing the two knobs Fig. 4, together and opening the carriage.

Remove the plate Fig. 13, Illustration No. 4, to which the solenoid coil and plunger assembly is attached by taking out the four screws Fig. 14, in the frame. Turn the solenoid mounting plate Fig. 13, around 180° so that the plunger Fig. 15, which engages the film holder carriage fits into the hole at Fig. 16. Install the terminal board Fig. 17, exactly as it was before with respect to the frame of the film shifter. Be sure that the fiber sheet Fig. 18, is placed beneath the studs which support the terminal board.

Turn the film shifter assembly over on the opposite side. Remove the plunger Fig. 19, Illustration No. 3, from the bracket Fig. 20, by taking out the screw Fig. 21. Reverse the position of the plunger so that it extends upward from the bracket Fig. 20 and install the screw Fig. 21 from the bottom side of the bracket. The spring inside the left spring casing Fig. 8, Illustration No. 3, must be released. To do this grasp the sleeve Fig. 2, and remove the screw Fig. 22, from the bracket Fig. 23. Now grasp the spring holder Fig. 24, Detail "A" and remove the small screw Fig. 25. Pull the spring holder out of the sleeve and unhook the spring. Holding the spring, allow it to recoil into the sleeve and then release it entirely.

Reinstall the spring holder in the sleeve and fasten the assembly back on the bracket Fig. 23. Take out the screws Fig. 30, and remove the Bracket Fig. 27, which holds the cylinder Fig. 28, on the film shifter frame. Follow procedure outlined in preceding paragraphs. The unit is now ready to be installed on the Photo-Roentgenoscope.

Place the cylinder Fig. 28, over plunger Fig. 19, Illustration No. 3, with adjustment screw Fig. 34, at the top of frame Fig. 7. Fasten it to the frame Fig. 7, over the holes Fig. 31, with screws removed from Fig. 30.

To complete the installation, follow paragraphs on General Operation and Adjustments.

If the shifter does not complete its travel after following the adjustments

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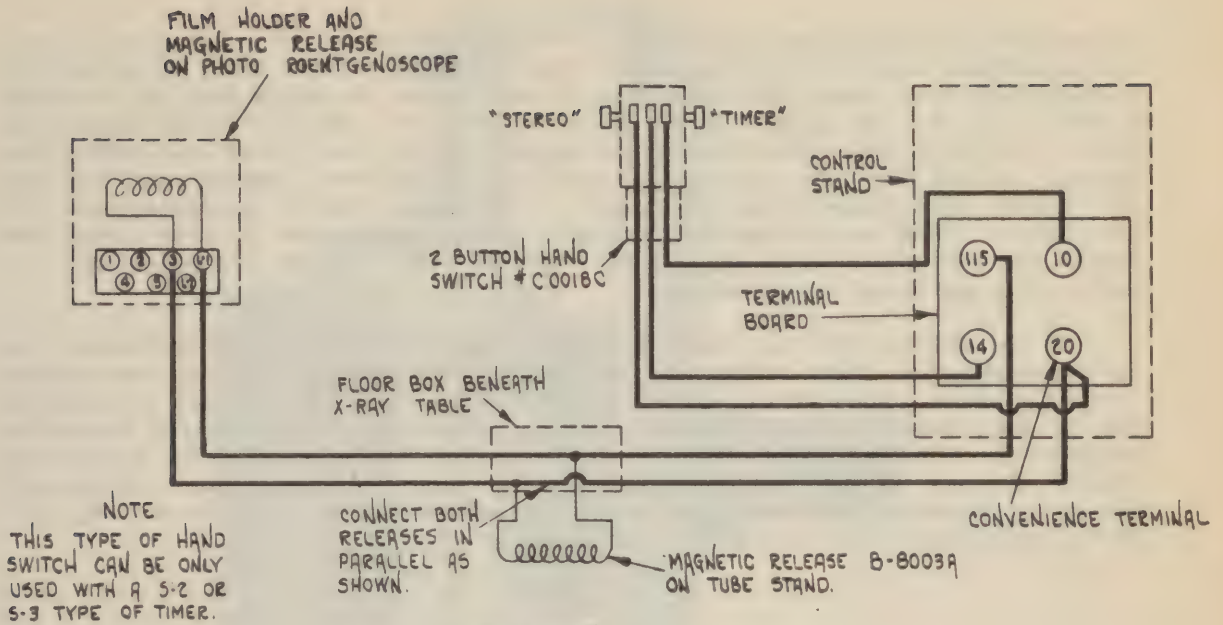


DIAGRAM # 1
2-BUTTON HAND SWITCH

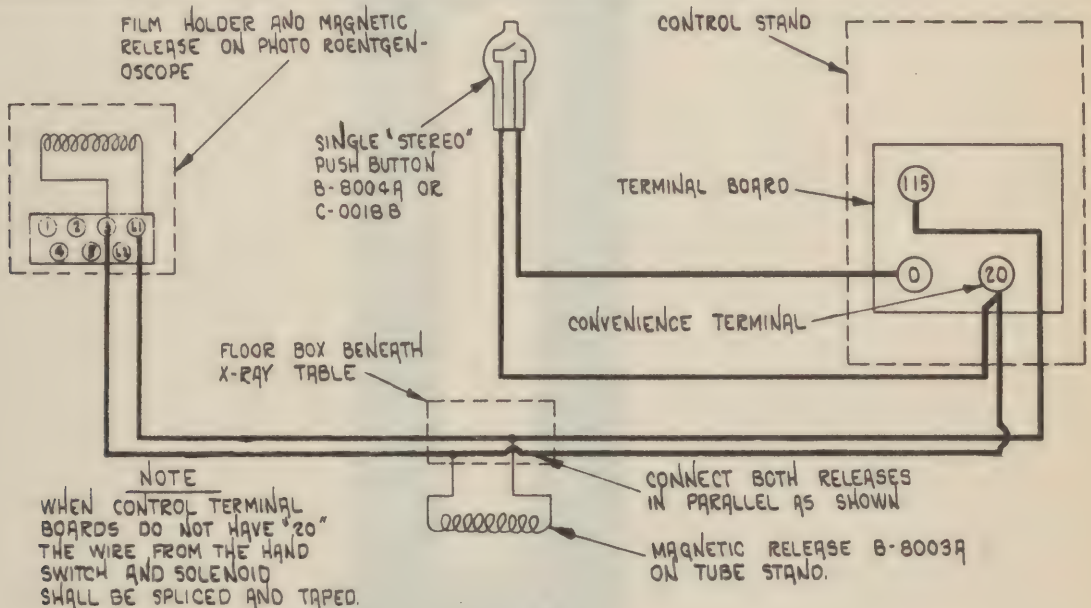


DIAGRAM # 2
SINGLE BUTTON HAND SWITCH

MAGNETIC RELEASE FOR PHOTO ROENTGENOSCOPE

SCHEMATIC DIAGRAM # 1 AND # 2 SHOWS CONNECTIONS TO BE MADE WHEN A RELEASE IS CONNECTED TO A KX-11, KX-12 AND KX-8 TYPE 5, 6, AND 7 X-RAY OUTFITS, DIAGRAM # 2 MAY BE USED ON ANY TYPE OF INSTALLATION.

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as outlined, the stud Fig. 36, Detail "A" inside of the right spring casing must be removed and replaced with the longer stud furnished. To do this, place shifter in lower position. Grasp the sleeve Fig. 2, and remove the screw Fig. 22, from the bracket Fig. 32. Now grasp the spring holder Fig. 24, Detail "A" and remove the small screw Fig. 25. Pull the spring holder out of the sleeve and unhook the spring. Do not allow the springs to recoil into the sleeve. Remove stud Fig. 36, and replace with longer stud furnished. Screw longer stud in approximately 1/4" of threads. Hook on spring and reinstall the spring holder in the sleeve and fasten the assembly back on the bracket Fig. 32. Now complete the adjustments as outlined in paragraph on Adjustments.

If the shifter does not complete its travel after the above adjustments, the spring inside the right spring casing must be stretched to relieve some of the initial tension. To do this, place shifter in lower position. Grasp the sleeve, Fig. 2, and remove the screw Fig. 22, from the bracket Fig. 32. Now grasp the spring holder Fig. 24, Detail "A" and remove the spring holder out of the sleeve and stretch spring. Do not allow spring holder to snap back up in place. Reinstall the spring holder in the sleeve and fasten the assembly back on the bracket Fig. 32. Repeat adjustments as outlined in paragraph on Adjustments.

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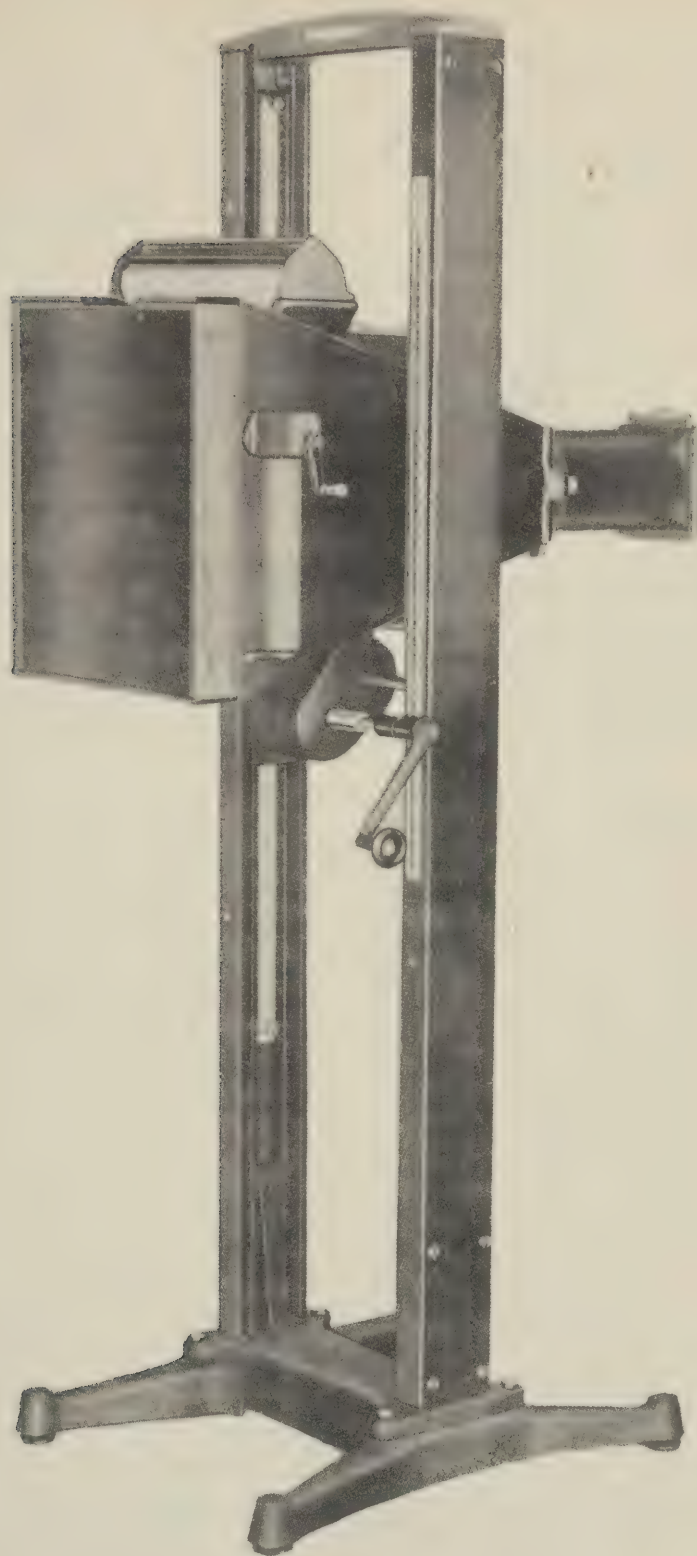


PHOTO-ROENTGENOGRAPHIC UNIT

SECTION LIII

ROUTINE FOR INSPECTION OF RADIOGRAPHIC UNITS

SECTION III

ROUTINE FOR INSPECTION OF
RADIOGRAPHIC UNITS

ROUTINE FOR INSPECTION OF RADIOGRAPHIC UNITS

The following is a tentative outline of what an inspection of x-ray apparatus should include. An x-ray unit in any military installation that is doing a large amount of work should be checked at least every month. In any inspection the following points should be checked:

1. Check all knobs and controlling levers for looseness and position.
2. Check to see that every knob and lever is doing what it is designed for; that is, a lever used to lock the bucky should do so.
3. Check, especially tube stops on tube support to see that they have not worked loose and slipped out of adjustment.
4. Check horizontal and vertical shifts to see that air cushion or oil cylinder chambers have not changed adjustment.
5. Check for proper adjustment and ease of movement of all parts of the unit including tube slide, tubestand, bucky, fluoroscopic carriage.
6. Clean all bearing surfaces and tracks with solvent - non-inflammable carbon tetrachloride, then relubricate with a light oil or grease removing the excess with cloth.
7. The inside of all fluoroscopic tables should be wiped out thoroughly and the insulators should be wiped clean. If they feel sticky, they should be cleaned with carbon tetrachloride.
8. The fluoroscopic tube should be wiped with care so as not to change its position thereby changing the focus on the screen. Make certain that the lead glass shield is tight as temperature changes in the tube have a tendency to loosen it. Check filament connections on tube. Twice a year the fluoroscopic tube and shield should be dismantled and washed with soap and water, thoroughly rinsed and dried. This will help to prevent sparkovers. Check the fluoroscopic shutters.
9. In case of motor drive table, motor should be oiled twice a year. Excessive oil will run over and saturate wiring, so do not use too much.
10. If a shockproof tube is used when checking for the first time, remove cables, clean terminals with carbon tetrachloride and cover with vaseline. After that, the vaseline should be cleaned about every six months, and a new coat put on. The cables should be removed each month to look for possible creepage of high tension.
11. If checking for the first time, check oil level in high tension transformer. It should be between 1/2 to 3/4 inches to top of tank, after this check yearly for oil level, but check monthly for oil creepage and leaks. The whole transformer should be wiped clean and dry during each inspection.
12. If checking a contactor for wear and adjustment, replace contacts if indicated, then twice a year they should be checked unless it is used extensively then it should be checked every three months.
13. The circuit breaker should be checked about once a year for setting maximum overload point.
14. The filament of the x-ray tube should be checked for evaporation. Take one

ROUTINE FOR INSPECTION OF RADIOGRAPHIC UNITS

setting about the middle of the used working range and if it is found to check with the original previous reading then all the settings may be O.K. and may not require checking. A ballistic meter is not needed if the filament checks on a low value.

15. Normally, synchronous timers should be checked about twice a year, unless one is suspicious of inconsistent radiographic results-Spinning top test.

16. On valve rectifiers check valve filament setting every time and reset if found low, but if found abnormally low, check to see that all valves light before boosting settings. Check valve voltage at socket in tank.

17. Before leaving an inspection, it should be seen that it is left as clean and neat as possible. Clean all meter glasses.

18. Leave the control settings as they were found.

19. If unit was set for fluoroscopy, leave it that way.

20. Make it a point to ask the operator how the unit has been acting if normal or otherwise, this should be done before the inspection is started so that if it acted abnormal the reason should be found first and corrected if possible. Have the operator keep a little note book so as to put questions in as he comes across them in daily work.

21. Check time limit switches.

SECTION LIV

U.S. ARMY PROCESSING UNIT

SECTION LIV

U.S. ARMY PROCESSING UNIT

U. S. ARMY PROCESSING UNIT



U. S. ARMY PROCESSING UNIT

WESTINGHOUSE FILM PROCESSING FIELD UNIT

The following instructions should be carefully read before attempting to assemble or operate the apparatus.

UNPACKING - Carefully unpack the various boxes and crates in which the equipment is received and examine it for possible damage. The complete apparatus consists of a base containing the actual cooling unit, an upper main reservoir tank, a "developer" tank, a "fixer" tank, a dark room timer, a dark room safe-light, a refrigerant valve-stem wrench, and a bleeder valve-stem key.

If an auxiliary wash tank is to be used, the shipment will also include an auxiliary base, an auxiliary upper reservoir tank, a water level equalizer tube, and one rubber interconnecting hose.

The Westinghouse Style No. 980205 Temperature Controlled Film Processing Unit has been designed to maintain an average water temperature of 65° F. in the main reservoir tank under average conditions of ambient temperature when the unit has been installed and operated in accordance with the following instructions.

WEIGHTS - Base Assembly, 225 lbs; Upper Tank Assembly, 150 lbs.

POWER REQUIREMENTS

Volts: 115 A.C.	Frequency: 60 Cycles
Amps : 14	Phase : 1

Note: Do not connect power to equipment until called for in the instructions. Do not operate the equipment without water. Always ground unit before connecting power.

ASSEMBLY - Assemble the equipment carefully, and in accordance with the step-by-step instructions which follow. All water valves and connections are identified by means of numbered metal tags. Other parts, as well as the refrigerating unit proper, are identified on drawing 7-A-3329.

1. Set base in place in location where it is to be used, making certain that it is reasonably level to insure proper splash lubrication of the compressor. The side with the water pump should be kept to the front. A cool, dry, well ventilated place is preferable. Allow at least twelve inches of air space all around the unit to permit proper air circulation. Avoid arrangements whereby heated air discharged from the refrigerant condenser will be recirculated. In permanent installations, allow sufficient room for servicing. NEVER INSTALL THE UNIT WHERE IT WILL BE EXPOSED TO FREEZING TEMPERATURES (32 F.) AFTER IT IS SHUT DOWN, UNLESS PROVISION HAS BEEN MADE TO DRAIN ALL WATER FROM THE ENTIRE SYSTEM.

2. Remove the four perforated side covers from the base. Loosen the three castellated hexagonal nuts on the base of the sealed compressor until they stop against the cotter pin passing through each of the studs. The compressor should now float freely on its three mounting springs. If for any reason it becomes necessary to transport the unit, the three nuts must first be locked into place. Failure to take this precaution may result in broken connections with consequent loss of the refrigerant. On units in which rubber mounts are used instead of springs, this step may be disregarded.

3. Screw the long one inch overflow pipe to its fitting inside the main reservoir tank. Screw the long screened outlet pipe to its fitting alongside the one inch pipe. Screw the short screened inlet pipe to the remaining fitting inside

U. S. ARMY PROCESSING UNIT

the tank. Do not use a wrench on these pipes -- they should be fastened hand-tight only.

Carefully place the main reservoir tank in place on the base with the long one inch overflow pipe to the left rear.

4. Connect tank coupling No. 1 to the short, screened tank inlet pipe on the right front.

Connect one No. 2 coupling to the long screened tank outlet pipe on the left rear.

Connect the other No. 2 coupling to the long one inch overflow pipe on the left rear.

Lock the tank firmly in place by means of the four thumbscrews provided on the base.

5. Mount safelight and dark room timer to rear of tank with brackets provided. The safelight mounts on the left and the timer on the right.

6. Place the stainless steel developer and fixer tanks into the main reservoir tank. Fill the smaller tank with developing solution and the larger tank with hypo (fixer).

7. Connect unit to a good ground by means of the grounding lead provided. Making this connection to a cold water pipe is to be preferred, but if this is not available, a piece of 3/4 in. diameter metal rod or pipe, driven at least three feet into moist earth, will do. The point of contact between the ground lead and rod or pipe should be thoroughly clean and bright.

8. (a) Connect community drain piping to fitting No. 5 on lower end of one inch overflow pipe, and to fitting No. 4 on the No. 4 valve. *Note: Valve No. 3 is the MASTER WATER DRAIN VALVE to be used only when the equipment is to be subjected to freezing temperatures and it is desired to drain all water from the entire system. It is not intended to be used for routine draining of the reservoir tank.*

(b) Connect community cold water supply to coupling No. 4 on the calibrated No. 4 valve.

(c) Close valve No. 3.

Close water drain cock No. 3 on mixing chamber.

Close air bleeder valve on mixing chamber (use key provided).

Open calibrated valve No. 4 all the way by giving it a half turn to the 65° position at which it will stop.

NOTE: ALL WATER VALVES AND COCKS CLOSE IN A CLOCKWISE DIRECTION.

(d) Open the community supply line valve (not part of the equipment) slowly until it is completely open. When the water level in the main reservoir tank has reached the top of the one inch overflow pipe, shut off the No. 4 calibrated valve by giving it a half turn to the "closed" position. *Note: Do not use excessive force when operating the calibrated No. 4 valve, or the accuracy of the calibration may be affected. Turning it gently to the "closed" position will effectively shut*

U.S. ARMY PROCESSING UNIT

off all water flow.

At average community water pressures of about 45 lbs. per square inch, it should take about two hours to fill the tank. If faster filling is desired, a supplementary source of water supply should be provided and the water fed into the tank by a hose or other suitable means.

9. If a community water and drain supply is not available, proceed as follows:
 - (a) Close valve No. 3.
 - (b) Close water drain cock No. 3 on mixing chamber.
 - (c) Close air bleeder valve on mixing chamber (use key provided).
 - (d) Close calibrated valve No. 4.

Fill the main reservoir with water of a temperature as close to 65° F. as it can be obtained until the water level has reached the top of the one inch overflow pipe. With the developer and fixer tanks in place, the main reservoir tank capacity is approximately 41 gallons.

10. With the reservoir tank filled to the proper level, examine all three couplings underneath the tank, as well as other parts of the system for leaks.
Note: The liquid line valve, suction line valve, and receiver valves are all open.

11. Connect the equipment to a single-phase, 115 volt 60 cycle A.C. power supply. Turn on the line pump, heater, and cooler switches located on the lower right front side of the base. Both the condenser fan and water pump should now begin to operate. The sealed compressor unit will also operate if the water temperature is above 65° F. With the starting of the compressor, the refrigerant will be free to circulate throughout the system, and the compressor should be permitted to operate until it shuts down automatically. If the water temperature is below 65° F. the heater unit will operate instead of the compressor.

12. To make certain that the water circulating system is functioning properly and that the water pump has not become air-bound proceed with the following steps, WITH THE UNIT IN OPERATION.

- (a) Check water level in main reservoir tank to make certain it is even with the top of the one inch overflow pipe.

(v) By means of the key wrench provided, carefully open the "Air Bleeder Vent" very slightly. (This is located at the heater end of the mixing chamber-See "rear view"). Keep this vent open until all trapped air has left the system and water begins to come out freely after which it should be closed. Be careful not to allow water from this vent to come in contact with the heater relay in the housing directly underneath.

(c) As a final check on whether circulation is taking place, hold a small piece of soft paper over the long screened outlet pipe located near the one inch drain line. If the paper is sucked to the pipe, the water system is circulating satisfactorily. IT IS IMPORTANT THAT ALL AIR BE REMOVED FROM THE WATER SYSTEM IF PROPER TEMPERATURE CONTROL IS TO BE OBTAINED. The water pump will continue to operate even when the compressor shuts down automatically. The pump will operate all the time providing its switch is in the "On" position. Throwing off the "Line" switch will completely shut down the entire unit. Should the pump circuit breaker switch ever trip off automatically due to overload, it can be reset as follows:

- A. Allow about 20 seconds for the thermal element within the switch to cool.

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B. Push switch lever firmly to its "Off" position.

C. Then push lever to "On" position.

13. The equipment is now in full operation, and the temperature of the water in the main reservoir tank will be raised or lowered (depending upon the initial temperature of the water) until an average value of 65° F. is reached, at which temperature it will be maintained over a range of from 62 to 68 degrees Fahrenheit. All controls have been carefully set at the factory, but as an additional check on a new installation, a thermometer should be suspended in the main body of water at about the center of the tank and readings taken whenever the heater relay operates. At 62° F. the cooling unit compressor should automatically shut off and the heater turn on. At 68° F. the heater should automatically turn off and the cooling unit compressor turn on. If the final thermometer readings, after equilibrium is reached, are found to be respectively lower or higher than these values, a corresponding adjustment of the water temperature control will have to be made. If the community water, or ambient temperatures are higher than 65° F. the "Heater" switch should be turned off and the "Cooler" switch turned on. If lower than 65° F., the "Heater" switch should be turned on and the "Cooler" switch off. Turning off the "Line" switch disconnects all circuits from the main line.

14. **WATER TEMPERATURE CONTROL** - The adjustable water temperature control maintains the water in the mixing chamber at a constant average temperature, depending upon the setting selected. (IT IS THE ONLY ADJUSTMENT PROVIDED FOR DIRECTLY CONTROLLING THE WATER TEMPERATURES.) It has been set for 65° F. at the factory, which should be satisfactory for all normal operation. However, if it should become necessary to make an adjustment, loosen the locking screw on the range adjustment lever and move the latter to the left to lower the average water temperature, and to the right to raise it. The cover should be removed and the contacts observed during this operation. Move the adjustment lever only sufficiently to make or break the contacts, as the case may be, in order to avoid going too far past the desired setting.

In operation the water temperature control automatically turns both the cooling compressor, and the heating unit on and off through its relay as the occasion demands. As the temperature of the water in the mixing chamber drops to 62° F. the contacts of the water temperature control close, thereby energizing the relay which in turn opens the compressor motor circuit and turns on the heater. As the temperature rises to 68° F., the control contacts open, de-energizing the relay which opens the heater circuit and starts the compressor. This cycle is repeated continuously as long as the equipment is in operation.

IT IS IMPORTANT THAT THE ACTUAL AUTOMATIC SHUTTING OFF AND STARTING OF THE COMPRESSOR BE PERFORMED BY THIS CONTROL AND NOT BY THE REFRIGERANT PRESSURE CONTROL. WHENEVER A CHANGE IN ADJUSTMENT IS MADE ON THE WATER TEMPERATURE CONTROL THIS POINT SHOULD BE CHECKED.

15. **REFRIGERANT PRESSURE CONTROL** - The refrigerant pressure control directly controls the operation of the sealed-in compressor insofar as circulation of the refrigerant is concerned but provides no direct control over water temperature.

It has two adjustments, one marked "DIFF." and the other "RANGE". The DIFFERENTIAL ADJUSTMENT SHOULD NEVER BE TAMPERED WITH EXCEPT BY A QUALIFIED SERVICE MAN SINCE SPECIAL EQUIPMENT IS REQUIRED TO SET IT PROPERLY.

The range setting should be changed only if it is noted that the refrigerant

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pressure control turns off the compressor motor before the Water Temperature Control has had a chance to perform this function. If such is the case proceed as follows:

(a) Remove cover of Water Temperature Control.

(b) Turn range screw on Refrigerant Pressure Control one-half turn in the "Colder" direction as indicated by the arrow.

(c) Wait for compressor to start automatically and observe whether closing of the contacts in the water temperature controls turns off the compressor.

(d) If the compressor stops before the water temperature control contacts have closed, turn the range screw another half turn in the "Colder" direction and repeat the observation in paragraph "C" above. Continue adjusting the range setting in the "Colder" direction, one-half turn at a time, until the compressor is turned off only by the closing of the Water Temperature Control contacts. **DO NOT USE THE RANGE SETTING TO OBTAIN A LOWER WATER TEMPERATURE - ONLY THE WATER TEMPERATURE CONTROL CAN BE USED FOR THIS PURPOSE.**

If it is desired to have a flow of community water blend continuously with the recirculated water in the reservoir tank, proceed as follows:

(a) Measure community water pressure and insert proper orifice into union on calibrated No. 4 valve.

(b) Determine temperature of community water with a thermometer. *Note: Allow community water to run freely for at least 15 minutes before taking the final reading.*

(c) Set the pointer of the calibrated No. 4 valve to the F. temperature value on the dial which corresponds closest to the final thermometer reading.

(d) The water now passing through the unit will be a mixture of community and recirculated water, part of which will continually flow into the community drain over the top of the one inch overflow pipe in the tank. It is important that the calibrated valve be set very carefully if water temperatures in the main reservoir tank are to be maintained. The valve adjustment should be changed with the seasons, or whenever there is likely to be an appreciable change in community water temperature.

16. CALIBRATED WATER VALVE - The calibrated water valve, identified as the No. 4 valve on Drawing 7-A-3329, provides a convenient means for continually blending community and recirculated water in the main tank.

Since the quality of community water which can be admitted without upsetting the temperature balance of the equipment becomes a function of the community water temperature, this valve must be carefully set to conform to community water temperature at all times if satisfactory operation is to be expected.

It is provided with a fixed graduated dial calibrated in degrees Fahrenheit (from 40° to 90°), and an index pointer on the wheel. In operation the community water temperature is first determined in terms of degrees Fahrenheit, after which the wheel pointer is carefully set to the corresponding temperature value on the dial.

The 65 position on the dial represents the maximum opening of the valve while the 90 position represents the minimum opening. If it is desired to shut off all

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community water, the pointer should be set to the "closed" position.

Constant use of this valve over long periods of time may ultimately result in the introduction of slight inaccuracies due to normal wear of the valve-seat. If this should occur, the necessary correction can quickly be made as follows:

(a) Slowly turn valve wheel in a clockwise direction until the flow of community water just stops. Do not turn past this point by the use of excessive force.

(b) Loosen the four screws located on the inner circumference of the calibrated dial. This will permit the dial to turn.

(c) Turn the calibrated dial until the word "closed" is directly under the index pointer on the valve wheel.

(d) Tighten all four screws, being careful not to upset the adjustment.

17. CALIBRATED VALVE ORIFICE - The calibration of the calibrated water valve is based on a water pressure of about 10 lbs. per square inch at the valve-seat opening.

Inasmuch as the various temperature values on the scale of the calibrated valve actually represent different degrees of opening, and are themselves based on a given quantity of water flow through that opening at 10 lbs. per square inch pressure, it is important that this pressure be maintained at all times if accurate performance is to be expected.

In order to reduce community water pressures to the required 10 lbs. per square inch, three pressure reducing orifices, each with a different sized opening, are supplied with the apparatus.

The smallest, or 1/16 inch, size is shipped already mounted in the equipment and is suitable for community water pressures ranging from 20 to 50 lbs. per square inch. The intermediate or 3/32 size should be used on community pressures of 10 to 20 lbs. per square inch, and the largest or 1/8 inch size on 1 to 10 lbs. per square inch pressures.

To replace an orifice, open the small union on the No. 4 connection directly under the calibrated valve. Remove the orifice, replace it with one of the required size, and close the union.

18. WATER HEATER - The water heating unit, the terminals for which are located at one end of the mixing chamber, is of the immersion type, and has provision for three different degrees of heat. It can be turned on or off at will by means of the heater switch located on the lower right front of the base. If the community water, or ambient temperatures are higher than 65° F. the heater switch should be turned off and the cooler switch on. If lower than 65° F. the heater switch should be turned on and the cooler switch off.

The equipment is originally shipped with the heater terminals connected as a 1200 watt unit as shown in Fig. 3 on drawing 5-D-2239. However, if slower heating is desired, the heater may be connected either as a 600 or 300 watt unit by changing the connections as shown in figures 2 and 1 respectively on drawing 5-D-2239.

In order to avoid accidents, all power should be shut off at the main service switch before making any of the above changes.

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DISASSEMBLY, DRAINING, AND PREPARATION OF UNIT FOR TRANSIT:

- A. Remove four perforated side covers from base.
 - B. Turn off all switches and disconnect from power supply.
 - C. Shut off power at main service switch.
Shut off community water supply valve (not part of equipment).
Open calibrated No. 4 valve to 65 position.
 - D. Tighten the three castellated hexagonal nuts on the base of the sealed compressor unit. (*Note: Extreme force is not necessary in tightening these nuts.*)
On rubber mounted units, this step may be disregarded.
 - E. Unscrew the long, one inch diameter overflow pipe in the main reservoir tank in a counter-clockwise direction. This will allow all water in the tank to flow into the community drain.
 - F. Unscrew long, screened outlet pipe in main reservoir tank in a counter-clockwise direction.
 - G. Open the No. 3 master drain valve. This will allow all water remaining in the pipe lines and mixing chamber to flow into the community drain.
 - H. After main reservoir has been emptied, open water drain cock #3 on bottom of mixing chamber.
 - I. Disconnect community supply and drain lines from connections 3, 4 and 5, making certain that community supply line valve is closed.
 - J. After all residual water has drained from the equipment, close valves 3 and 4, and cock 3.
 - K. Disconnect the three main tank couplings.
 - L. Disconnect ground connection.
 - M. Remove safelight and dark-room timer from main tank.
 - N. Loosen the four thumbscrews holding main tank to base.
 - O. Lift main tank from base after developer and fixer tanks have been removed.
- Replace four perforated side covers on base. Unit is now ready for packing and transportation.

LUBRICATION

COMPRESSOR - The compressor contains a sealed-in charge of special oil and a bulls-eye is provided for determining the oil level. If the level is at least one-quarter the way up on the bulls-eye it may be considered as satisfactory. If the oil level is low, more oil must be added before the unit is operated. A special oil must be used and it should be added only by a qualified Service representative. The compressor should stand reasonably level during the operation so that all parts receive adequate splash lubrication.

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WATER PUMP - The water pump is lubricated by means of the two grease cups provided. A good quality of *medium grade* grease should be used. Care should be taken not to screw the cups down so tightly as to force grease into the pump impeller housing from where it will contaminate the circulating water. **IN ADJUSTING THE PUMP PACKING NUT TO COMPENSATE FOR PACKING WEAR, DO NOT TIGHTEN IT TO SUCH AN EXTENT THAT IT WILL CAUSE OVERHEATING OF THE PUMP SHAFT.**

WATER PUMP MOTOR - Remove the two oil filler vent screws and lubricate with a few drops of SAE-20 engine oil of a good quality. **DO NOT OVER-LUBRICATE.**

FAN MOTOR - *Do not oil the refrigerant condenser fan motor.* This unit has a sealed-in supply of lubricant which must not be diluted with oil.

REFRIGERANT - The refrigerant used in this equipment is a non-toxic gas known as Freon. The gas is practically odorless and leaks in the system can be detected only by very careful inspection. All work on the refrigerating unit proper should be done only by a qualified serviceman.

GENERAL PRECAUTIONS

1. Always make certain that the power supply conforms to the requirements called for in the instructions before connecting the equipment.
2. *Always ground the equipment before operating.*
3. Always anchor compressor base against vibration before unit is transported. On rubber mounted units disregard this step.
4. Always close the "Receiver", "Liquid Line", and "Suction Line" shut off valves before attempting any repair work on the mixing chamber.
5. Always keep the screw caps on all valves which are part of the refrigerating system. The caps aid in preventing unnecessary loss of the refrigerating gas.
6. Always keep the equipment in a reasonably level position when in operation.
7. Always try to fill tank with water which is as close to 65° F. as possible. This will result in less waiting time before the unit is ready for use.
8. Always locate the unit so that air can circulate about it freely.
9. Clean out accumulated dust from the condenser radiator periodically. Keeping this part of the equipment clean will greatly improve its cooling efficiency.
10. Do not use excessive quantities of oil or grease on parts requiring lubrication.
11. Do not lubricate the fan motor.
12. Do not fail to disconnect the three tank couplings before lifting reservoir tank to base.
13. Do not expose the equipment to freezing temperatures unless all water has been removed from the main tank and all parts of the circulating water system

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including the pump and mixing chamber.

14. Do not operate the unit without water - a burned out heater may result.

15. Never attempt to raise or shift the entire unit by means of the handles on the main tank.

16. During hot weather, remove the perforated rear and end cover plates. This will provide better air circulation and result in more efficient temperature control.

17. If for any reason the water level should drop below the top of the long intake pipe, or the unit is not maintaining the desired water temperature, open the air bleeder vent in accordance with paragraph 12.

18. The screen mesh strainers on top of the outlet and inlet water pipes should be examined and cleaned periodically. Their purpose is to keep foreign materials out of the pump and other portions of the water circulating system, and they should be in place at all times while the unit is being operated.

AUXILIARY TANK - If an auxiliary wash tank is to be used with the main unit, read the instructions covering the main unit.

POSSIBLE TROUBLES AND THEIR CAUSES

I. WATER DOES NOT COOL:

Possible Causes:

No power. ("Cooler" or "Line" Switches open)

No water circulation

Mixing Chamber air-bound

Sealed compressor motor not operating

Refrigerating unit not cooling

Water temperature control not functioning

II. WATER DOES NOT HEAT:

Possible Causes:

No power ("Heater" or "Line" Switches open)

No water circulation

Mixing chamber air-bound

Heater element not operating

(a) NO POWER

Possible Causes:

1. Main line feeder switch open

2. Blown fuse

3. Broken wire

(b) NO WATER CIRCULATION

Possible Causes:

1. Water level below top of long screened outlet pipe. Add water and follow procedure in paragraph 15 of instructions.

2. Water valves not properly opened or closed in accordance with

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instructions. Read instructions and check all valves.

3. Water pump motor not operating. Check for "no power supply" broken connection, burned out motor, or stalling which might be caused by a broken pump impeller, or too tight a setting of the pump packing nut, Check "Line" switch.

4. Water pump air bound. Follow procedure as outlined in paragraph 15 of instructions. If this fails to clear all trapped air out of the pump, remove both grease cups (with pump still operating) and insert a toothpick or similar object into the bearing holes to break up the grease. After all air has been removed, replace the grease cups. (See instructions for water pump lubrication before replacing grease cups.)

(c) MIXING CHAMBER AIR BOUND

Possible Causes:

1. Unit sucking air through long screened inlet pipe because of improperly maintained water level. Open air bleeder vent in accordance with paragraph 12 of instructions.

(d) SEALED COMPRESSOR MOTOR NOT OPERATING

Possible Causes:

1. No power. ("Cooler" or "Line" Switches open)
2. Water temperature control contacts fail to open. Clean and readjust contacts. See instructions paragraph 14.
3. Relay not contacting properly on normally closed contacts. Clean and readjust contacts.
4. Refrigerant pressure control contacts dirty, or not closing properly. Clean and readjust contacts. See instructions, paragraph 15.
5. Starting capacitor burned out. Replace same.
6. "Liquid Line", "Suction Line", or "Receiver" shut-off valves not opened. This will cause refrigerant pressure control contacts to remain open. Open valves. See instructions.

(e) REFRIGERATING UNIT NOT COOLING

Possible Causes:

1. "Liquid Line", "Suction Line", or "Receiver" valves *only partly opened*. See instructions.
2. Loss of refrigerant gas due to broken line or slow leak.

(f) WATER TEMPERATURE CONTROL NOT FUNCTIONING:

Possible Causes:

1. Air in mixing chamber. Open air bleeder vent. See instructions, paragraph 15.
2. Thermostatic element defective, check setting of control with thermometer immersed in main tank water.
3. Moving contact jammed.

(g) HEATING ELEMENT NOT OPERATING:

Possible Causes:

1. No power. ("Heater" or "Line" Switches open)
2. Water temperature control contacts fail to close, or make poor contact.

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3. Relay not contacting properly on normally open contacts.
4. Burned out relay coil.
5. Poor connection on heater terminals.
6. Heater element burned out.

(h) REPAIR WORK ON THE MIXING CHAMBER:

The following procedure should be carefully followed if for any reason the mixing chamber connections are to be removed:

1. With compressor operating, close the "Liquid Line Shut-Off Valve" in clockwise direction with special wrench. Replace cap. (See paragraphs 11 and 12.)
2. After compressor has operated for about 60 seconds, and while it is still in operation, close the "Suction Line Shut-Off Valve" in a clockwise direction with special wrench. SHUT OFF ALL POWER TO COMPRESSOR IMMEDIATELY AFTER CLOSING THIS VALVE. SEE CAUTION IN PARAGRAPH 13-A. Replace cap. (See paragraph 11 and 14.) Most of the refrigerant has now been returned to the "Liquid Refrigerant Receiver Tank". If the compressor should automatically shut down while this step is being performed, remove the cover of the refrigerant pressure control (rear view drawing 7-A-3329) and close the contacts manually so as to keep the compressor running until this operation has been completed. *Note: Do not use the fingers in closing the contacts. They are both electrically alive. Use a dry piece of wood or other insulating material and gently press the upper movable contact until it touches the lower one. Do not use force--this is an extremely sensitive control device and is easily damaged by mishandling.*
3. With compressor shut down, close "Receiver Shut-Off Valve" in a clockwise direction with special wrench. Replace cap. (See paragraph 11 and 13.)

AFTER THE REPAIR WORK HAS BEEN COMPLETED, THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED TO RENDER THE UNIT OPERATIVE AGAIN. THE NEXT FEW STEPS INVOLVE HANDLING OF THE REFRIGERATING UNIT PROPER. PROCEED WITH CARE - READ THE INSTRUCTIONS CAREFULLY - AND EXERCISE EVERY PRECAUTION IN THE USE OF TOOLS TO AVOID DAMAGE TO SOME OF THE DELICATE CONTROLS AND PIPE LINES. DO NOT OPEN REFRIGERANT PIPE COUPLINGS OR IN ANY OTHER WAY TAMPER WITH THIS PART OF THE EQUIPMENT. ALL PORTIONS OF THE APPARATUS WHICH CARRY THE CIRCULATED REFRIGERANT ARE PAINTED EITHER ALL BLACK OR ALL GRAY.

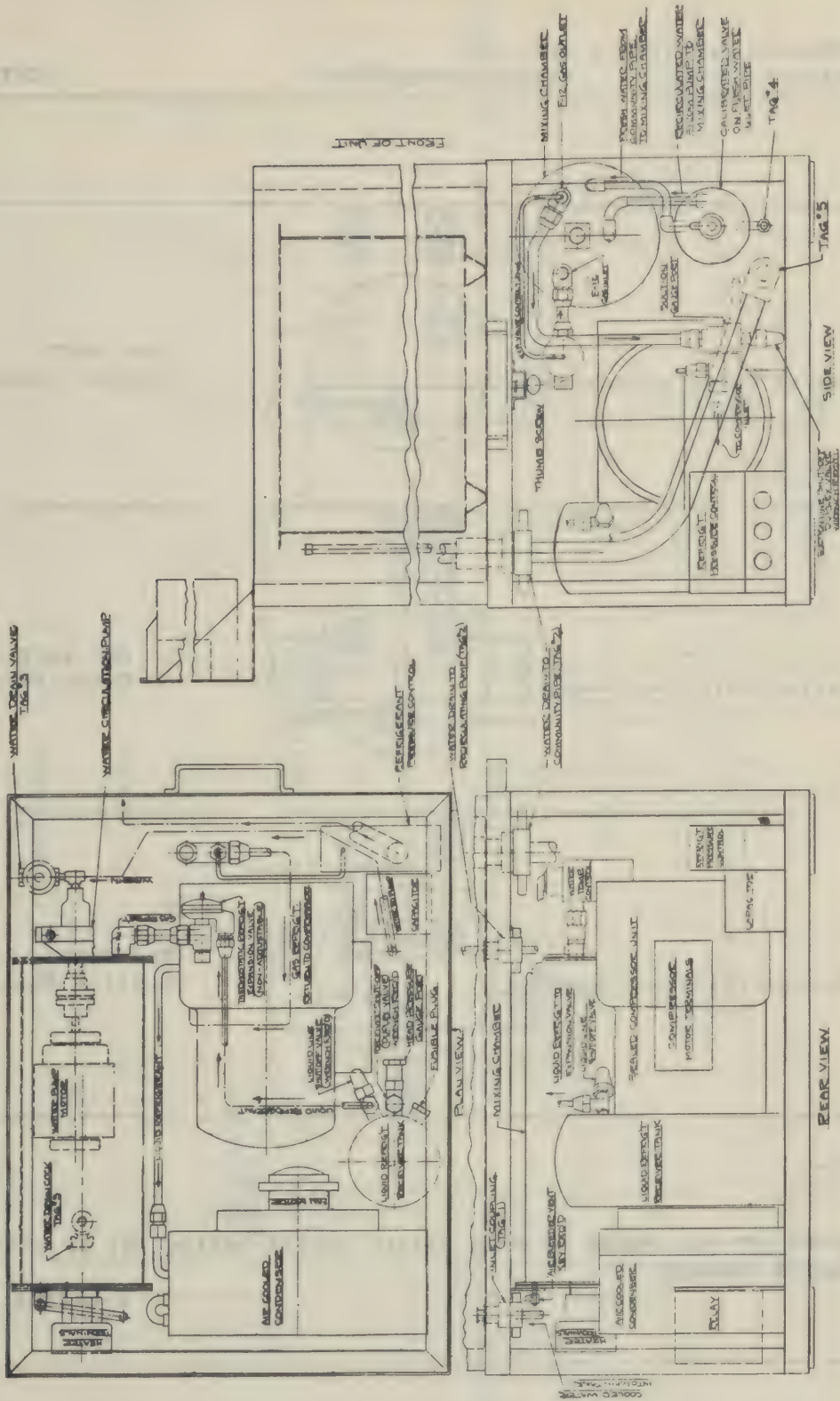
1. Remove protecting screw cap from the "Liquid Line Shut-Off Valve" located on the right side of the "Liquid Refrigerant Receiver Tank". This is the valve with the copper tubing coming off the top. (See "plan view" drawing 7-A-3329.)

2. Remove the protective screw cap from the "Receiver Shut-Off Valve" located on the right side of the "Liquid Refrigerant Receiver Tank."

3. Remove the protective screw cap from the "Suction Line Shut-Off Valve" located near the No. 5 fitting. (See "side view" drawing 7-A-3329.) DO NOT TAMPER WITH THE HEXAGONAL HEADED SCREW PLUG IN SUCTION GAUGE PORT OF THIS VALVE.

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ARMY PROCESSING UNIT INSTALLATION ASSEMBLY DRAWING



7-A-3329

U.S. ARMY PROCESSING UNIT

WESTINGHOUSE ELECTRIC & MFG. CO.
ARMY PROCESSING UNIT - HEATER CONNECTIONS

(INTERNAL)

Fig. 1,

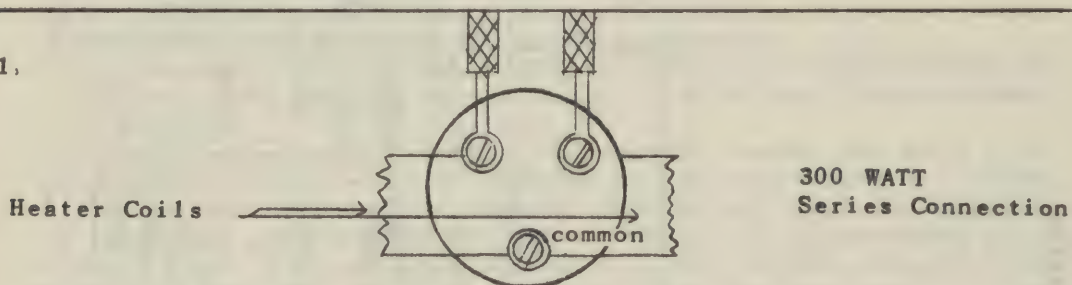


Fig. 2

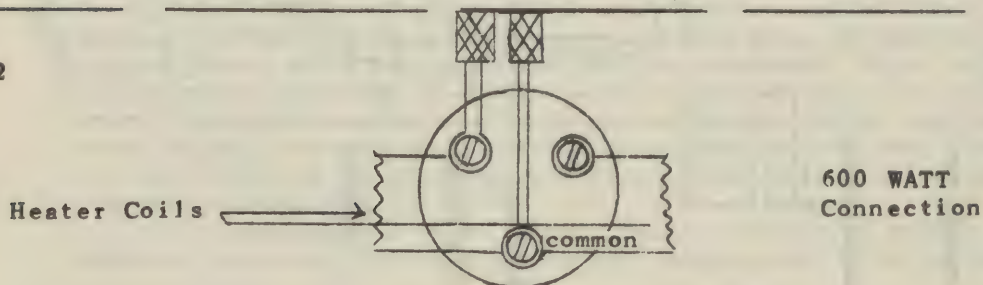
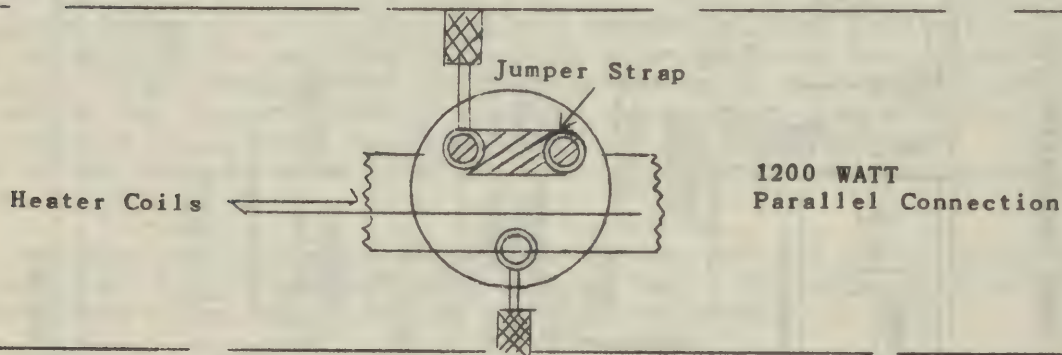


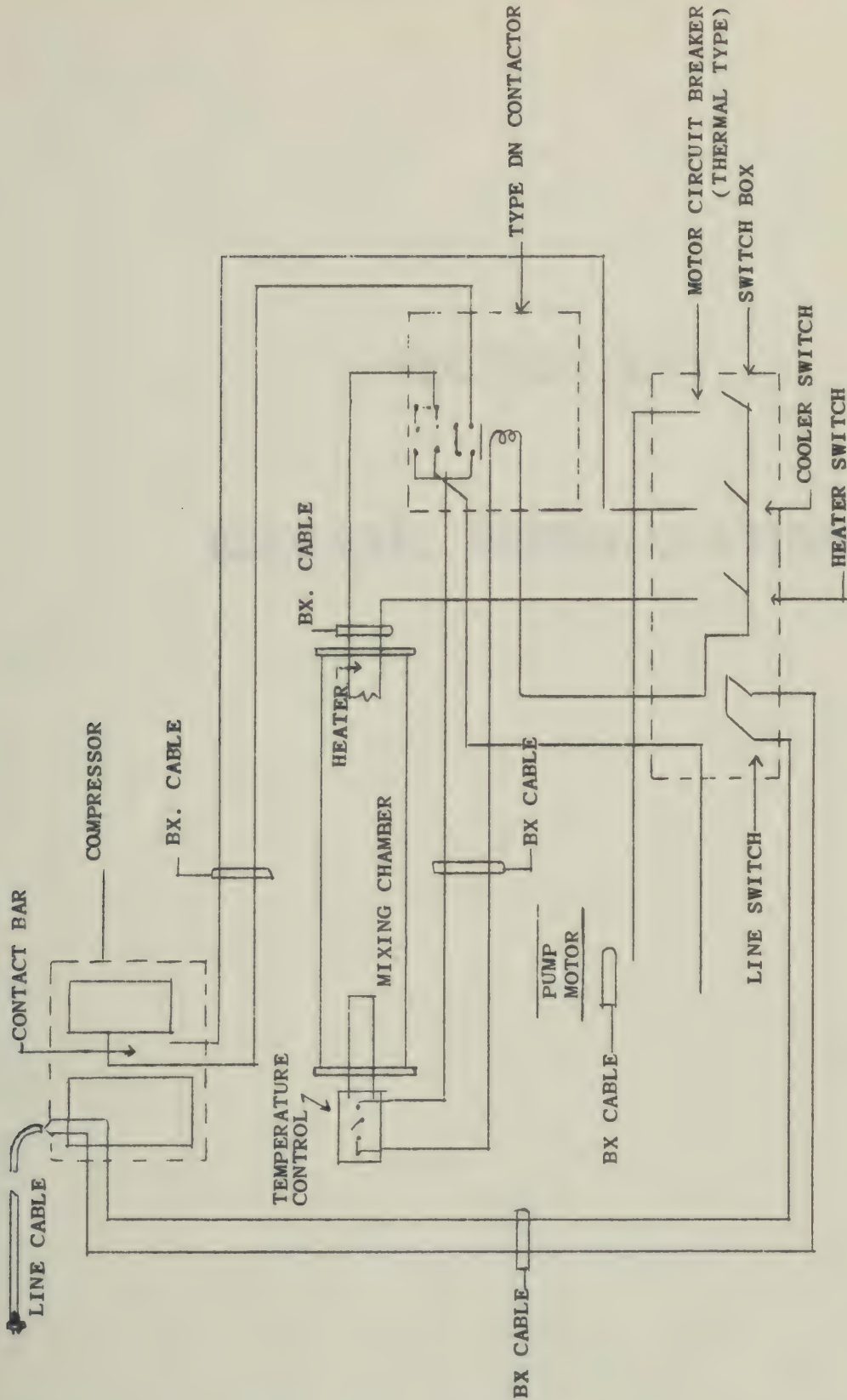
Fig. 3



WARNING

SHUT OFF ALL POWER AT MAIN SWITCH BEFORE MAKING ANY OF THE ABOVE CHANGES.

5-D-2239



75 - C - 806
29 - W

WESTINGHOUSE "FIELD UNIT" REFRIGERATING UNIT

SECTION LV

ELECTRIC REFRIGERATION

ELECTRIC REFRIGERATION

The purpose of this course is to make sure that each serviceman knows what can go wrong with a commercial refrigeration system and that he knows how to fix it. It is planned to do this in such a way that each man will be able not only to recognize and remedy all difficulties, but to pass on to others, if required, the same knowledge.

In order to do this, servicemen must be familiar with three things: namely, a few basic refrigeration principles, the relation between the various parts of a refrigeration system, and the mechanical features of the many devices used in a system.

Thorough understanding of these three points is necessary to enable the serviceman to determine quickly and accurately the cause of any failure. He must be able to tell the difference between a failure caused by misapplication and one caused by the product itself. Frequently he encounters a lot of failures of some certain type and blames them on the product. Actually the difficulty may lie in the wrong use or application of the product either by itself or in combination with others. On the other hand, it is recognized that actual product failure can and does occur. But it is the serviceman's job to run down the real trouble as promptly as possible, and to see that the proper remedy is applied with the least delay and the least expense.

With these thoughts in mind, this service course has been laid out to discuss:

The basic refrigeration system, its various parts, and how it works.

The multiple commercial refrigeration system, what it includes, and how it works.

The service problems met in both types of systems including the mechanical and operating features of automatic valves, controls, etc.

The service problems of specific products such as water coolers, storage cabinets, etc.

The problems of mechanical repair of assemblies such as condensing units, etc.

WHAT IS REFRIGERATION? - Briefly it is taking away some heat from a place it is not wanted, and disposing of it. This means that heat actually must be pumped out of one place and eliminated at some other place at a higher temperature just as water must be pumped from a well or a basement and dumped at a higher level.

To do this, a pumping system is necessary and, in its simplest form, such a system is shown in Drawing #1. In an evaporator or boiler, liquid refrigerant boils just as water in a kettle boils. But to boil the water, a lot of heat must be put into it by the fire. Likewise, to boil the refrigerant, a lot of heat must be put into it by the room or cabinet or whatever the heat is to be removed from.

The boiling refrigerant gives off vapor as boiling water gives off steam. This vapor contains a lot of heat, so it is piped away to the place where it is to be "dumped". To dump it at the higher temperature it must be pumped up, and this is done in the compressor. The compressor not only pumps up the vapor but keeps sucking out more from the evaporator. When pumped, the vapor becomes quite hot. Next, it should be cooled again and in so doing give up its heat just as the steam in a radiator gives off heat to a room. Therefore, the hot vapor is sent into the condenser where it not only cools but turns back into a liquid just as the steam condenses in radiators.

ELECTRIC REFRIGERATION

As the gas turns to liquid, it runs down into the receiver where it is stored until needed again. Actually, if a tremendous supply of refrigerant were available, and it did not cost much, it would not have to be condensed and reused. It would be pumped from the evaporator and exhausted to the atmosphere just as a steam locomotive exhausts.

From the receiver the liquid refrigerant flows through the liquid line to the refrigerant regulator and back into the "low side" to be boiled again. This refrigerant regulator is merely some kind of device that regulates the flow of refrigerant into the "low side" so that just the right amount is kept there at all times. This is to prevent the boiler overflowing and allowing the liquid refrigerant to run back into the compressor. The regulator may be one of several different types, but primarily it must do this one thing - regulate the flow of liquid refrigerant into the "low side" just fast enough - no faster and no slower.

Water boils at 212°F at normal atmospheric pressure. But if we went to the top of Pike's Peak, built a fire, put water on to boil, and measured its temperature with a thermometer, it would be found that the water would boil at about 190°F. This difference in boiling temperatures would be due entirely to the lower atmospheric pressure on top of the mountain. Similarly, refrigerant acts in the same way. When it is under a certain pressure, it has a certain corresponding boiling temperature. So in the simple system, by changing the pressure by means of the pump, the boiling temperature inside the evaporator can be changed. Thus by controlling the pressure the boiling point is automatically controlled.

PARTS OF A SYSTEM - THEIR NAMES AND DUTIES - Parts of the simple system can be most conveniently grouped together into assemblies for manufacturing purposes. This grouping naturally results in cooling units, condensing units, and control or accessory equipment. Cooling units are often spoken of as "low sides", meaning low-pressure sides since the lowest pressures are found there. Condensing units are less frequently called "high sides" or high-pressure sides, indicating that they operate under the highest pressures to be found in a system.

CONDENSING UNITS - Condensing units are usually classified as follows:

Units with air-cooled condensers.

Units with water-cooled condensers.

Condensing units can be further classified into two groups according to the type of drive. These are open conventional-type units with external motor, belts, pulleys, and shaft seal; and sealed-type or "motor-compressor" with direct-connected motor and compressor shut up in the same case without belts, pulleys, or shaft seal.

In most condensing units a liquid receiver is furnished. This is a tank or reservoir into which the liquid refrigerant runs from the condenser. On occasion, it is used to hold the entire charge in the system. Therefore, make sure that the receiver is big enough to hold the entire charge, or that additional receiver capacity is provided.

CONTROLS - The control group can be divided into two broad classes. One of these can be called refrigerant regulators and the other can be called merely controls for lack of a better term.

REFRIGERANT REGULATORS - Remember that the job of the refrigerant regulator is to keep the right amount of refrigerant in the "low side". Although not generally used for this purpose, a hand shutoff valve in the liquid line at the coil is the

ELECTRIC REFRIGERATION

simplest form of refrigerant regulator. If a hand valve were used, it would be necessary to adjust it continuously in order to keep liquid coming in at the same rate at which it was being boiled away. Since the rate of boiling will change throughout the day as the load varies, some automatic type valve is needed. Four types of such valves are used: the automatic expansion valve, the thermostatic expansion valve, the "high-side" float valve and the "low-side" float valve.

The thermostatic expansion valve is no mystery. There are only a few parts and it is similar to the automatic expansion valve except that it has an additional element or part that allows it to do things the automatic expansion valve cannot do.

IN A FEW SIMPLE WORDS - ALL THIS VALVE DOES IS KEEP THE COIL FULLY REFRIGERATED - It does *not* control temperature. It does *not* control pressure. You do *not* have to open it by hand to let refrigerant flow through it.

It can be recognized that in so far as the valve and bellows nearest the valve are concerned, it is exactly like the automatic valve. In addition to the spring found in the automatic valve, there is a longer push rod resting against a second bellows, also spring loaded. At the other side of this bellows is attached a very small tube called the capillary tube. This in turn ends in a small sealed cylinder called a bulb. This bulb has sealed in it a quantity of liquid refrigerant. The pressure inside the bulb and second bellows will correspond to the temperature of the bulb. This bulb is clamped rigidly to the suction end of the coil so that the bulb temperature will be governed by the suction line temperature at the suction outlet of the coil.

Suppose there is a man at the valve (Drawing #4) watching a pressure gauge, with one hand on the suction line, corresponding to the expansion valve bulb, and the other hand on the valve handle, corresponding to the first bellows. He looks at the gauge, decides that the hand on the line is too cold, and shuts down the valve a little. Or he thinks his hand is not cold enough according to the gauge reading, so he opens up the valve. In this way he maintains control continuously by considering the temperature of his hand with respect to what it should be according to the gauge reading. He does not care what the actual temperature of his hand is just so long as it is in agreement with the gauge.

The thermostatic expansion valve accomplishes the same results automatically in an identical manner. Its operation is as follows:

Assume the compressor is not running and the valve is closed. The control starts the compressor and immediately it sucks vapor from the cooling unit. This lowers the evaporator pressure and the pressure on the first bellows and permits the spring to push open the valve. Refrigerant rushes in and begins to boil and the evaporator and suction line begin to cool off. As the suction line cools, it cools the bulb, reducing the pressure in the bulb and second bellows so that the second bellows does not push against the rod quite so hard. This action continues until the bulb has been cooled enough so that the spring and the second bellows are not pushing hard enough to keep the valve open. The valve closes because the refrigerant that has rushed in is boiling and giving off vapor, thus tending to build up pressure in the evaporator and on the first bellows even though the compressor is running. This action corresponds to the closing of the valve by the man in Drawing #4. But now that the valve is closed, no more refrigerant is coming in and the compressor keeps sucking out vapor. Shortly there is no more refrigerant boiling in the evaporator near the bulb although there may be some still boiling back further in the evaporator. Therefore, the bulb does not stay quite so cold, and may warm

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up a little. As it does so, it builds up pressure in the second bellows again. Meanwhile, the compressor has been running and has started to lower the evaporator pressure once more. When this happens, the pressure in the second bellows and the spring become stronger than the pressure on the first bellows, and the valve again opens up. This would correspond to the opening of the valve by the man. Actually, as with the automatic expansion valve, the valve takes up a balanced position.

In one form of valve a diaphragm is used instead of the two bellows. The action of the valve is no different since the bulb pressure is exerted on the top of the diaphragm, and the evaporator pressure and spring pressure on the bottom. Consequently this type is governed by the same forces and performs the same duties as the valve discussed above.

The thermostatic valve not only keeps a balance between the spring pressure and the first bellows pressure, but by means of the second bellows it also keeps a balance between the first bellows pressure and the suction line temperature. In this way if too much refrigerant enters, the suction line says to the valve, "I'm too cold," and the valve closes off a bit. If not enough refrigerant gets in, the suction line says, "I'm not cold enough" and the valve opens up to let more in.

In Drawing #4 the valve, as delivered, is set so that no more boiling takes place beyond some point "X". If the adjusting nut is screwed in (right-hand thread), more pressure is put on the spring in the second bellows making it unnecessary for the second bellows itself to push so hard to overcome the main spring. Thus the bulb does not have to warm up so much to make the second bellows open the valve. Therefore, point "X" will move closer to the bulb. If the nut is screwed the other way, the reverse action takes place and point "X" moves away from the bulb.

Since this valve keeps a balance between the pressure in the evaporator and the temperature of the suction line and does not try to hold any particular pressure, the suction pressure can be varied at will without the occurrence of "flood back" no matter how the load changes. If heat can be removed from the evaporator faster than it comes in, the pressure can be pulled down to any point within the limit of the compressor and a pressure operated type of control can be used.

On the off cycle the valve will remain closed, provided the evaporator and the bulb warm up together. If they do this, the pressure will build up equally in both, and the valve stays closed. If the bulb warms up much faster, its pressure soon becomes greater than the evaporator pressure which is also the pressure on the first bellows. When this happens, the first bellows cannot hold the valve closed any longer. Liquid refrigerant flows into the evaporator and is sucked out immediately when the compressor starts causing a "flood back". This liquid may go clear back to the compressor and since the compressor is a gas pump, its valves are not designed to handle liquid. Therefore, under such conditions some damage may be done.

It is not so essential to remember what each bellows does, but it is important to know *what* the valve does. It keeps the coil fully refrigerated by keeping a *balance* between the pressure in the coil and the temperature of the suction line, no matter what the actual thermometer or gauge values of the temperature and pressure may be. To keep this balance it regulates the flow of refrigerant into the coil.

Therefore, when on a service call, or when starting a new job, do not disturb the valve. In all probability it is keeping its balance as it should. If something is wrong it is more than likely that the valve is not to blame. Make very sure that *everything else* is all right before you start adjusting the expansion valve. There are some instances in which a change in the valve setting is permissible. These

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will show up later in the discussion, but even in those cases the valve is not necessarily at fault.

OTHER CONTROLS - There are two classes of other controls: thermostatic and pressure operated. There are many different forms of both of these classes, but a thermostat is always a control instrument operated by temperature changes and a pressurestat or pressure control is one operated by pressure changes.

Thermostats are generally used for controlling the temperature inside a single fixture. Pressure controls are usually used to stop and start condensing units. In the thermostat, temperature changes cause the element to expand or contract, and in the pressurestat changes of pressure cause the element to do the same thing. These changes in the element make contacts open or close depending on how the instrument is designed. The elements may be bimetallic strips, bellows alone, bellows with a bulb, and so on.

HEAT EXCHANGERS - Servicemen are interested in knowing what heat exchangers are and where they go. They are devices for interchanging heat from the warm liquid to the cold suction gas. To cool the warm liquid down to the evaporator temperature requires some refrigeration, and without a heat exchanger this refrigeration must be done in the "low side" thus cutting down on the useful refrigeration the evaporator can do. Exchangers are useful in eliminating sweating suction lines and in helping installations that are slightly under capacity.

In its simplest form, a heat exchanger is one tube within another with the liquid usually between the two tubes and the suction gas inside the inner tube. By putting fins on the inner tube it can be made more effective and the length of the exchangers cut down. To be effective the exchanger should be connected as nearly as possible to the suction outlet of the evaporator.

OPERATION OF THE SIMPLE SYSTEM - Suppose a simple system with an air-cooled condensing unit and a blower type cooling unit in a walk-in cooler has just been installed. Upon starting, the sequence of operation is as follows:

The whole system is warm and has the same temperature throughout. A pressure gauge on the suction line will show a high pressure corresponding to the high temperature in the system. Then the compressor starts, it begins to suck refrigerant vapor out of the cooling unit, lowering the pressure. Lower pressure means that the refrigerant in the cooling unit is becoming colder, heat will flow in from the air around it and will boil away more refrigerant. With the compressor sucking vapor out of the cooling unit, and heat boiling the liquid to make more vapor, the pressure, and with it the temperature, will fall until the heat coming into the cooling unit makes vapor just as fast as the compressor can pump it away.

As the compressor continues to run, heat is removed from the cooler and the air temperature begins to drop. To keep on boiling, the refrigerant temperature also must decrease. The suction pressure steadily falls lower and lower as the air temperature falls. Soon the suction pressure is down to perhaps 17 lb. and the air temperature in the cooler is down to 38 degrees. That should be low enough. A thermostat in the cooler set to stop the condensing unit when the temperature drops to 38 degrees could be used for control.

After the compressor has stopped no more vapor is pumped out of the cooling unit. The pressure will increase until the temperature of the cooling unit is the same as the temperature of the air around it and the liquid will not boil any more.

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During this time, heat has been steadily "leaking" into the air of the cooler through the walls and perhaps from some of the meat and vegetables that have not yet thoroughly cooled. Soon the air temperature is back to 42 deg. and the thermostat starts the compressor to cool the air down to 38 deg. again.

Instead of a thermostat, a "Back Pressure" control could be used. This control would have to be set to stop the unit when the pressure reached 17 lb. which occurred at the same time the air temperature was 38 deg. and start again when the pressure reached 36 lb., which was the pressure in the cooling unit when the air reached 42 deg. How long it takes to pull down to the cut out temperature, and how long to warm up again, depends upon how fast the heat is leaking into the air.

One very important thing occurring in this process is "frosting" and "defrosting". When air is cooled in a cooling unit that is colder than 32 deg., moisture from the air condenses on the surface of the cooling unit and unfortunately freezes there. Frost is not a good conductor of heat. If it were allowed to accumulate, it would very seriously interfere with the operation of the system. To prevent frost accumulation it is necessary, each time the condensing unit stops, to prevent its restarting until the cooling unit has warmed up enough to melt off frost. With a back pressure control it is easy to do this by making sure that the cut-in pressure is higher than 30 lb. (corresponding to 32 deg.). However, it certainly cannot be set higher than the pressure corresponding to the maximum permissible air temperature, in this case 42 deg. to 39 lb. Consequently, it is not possible satisfactorily to hold temperatures below about 35 deg. in a cooler without providing some other way to defrost, since it takes a long time to melt ice with 33 or 34 deg. air.

Defrosting a cooling unit is important for another reason. Since the condensing unit must be turned off a certain amount of the time to allow defrosting, it certainly cannot provide refrigeration 24 hours out of each day. In fact, it is necessary to allow a total of 8 hours each day for defrosting. Therefore, the units must be capable of doing a full day's work in only 16 hours.

The compressor and condenser act exactly opposite to the cooling unit and compressor. That is, the compressor pumps hot vapor into the condenser, where it turns into liquid by giving up heat to the surrounding air, or water, as the case may be. The "high side" or "head" pressure is thus fixed by the ability of the condenser to liquify the vapor as fast as the compressor pumps it over. The higher the air or water temperature and the higher the pumping rate of the compressor, the higher will be the head pressure. This means that the higher the head pressure and back pressure the more work the motor has to do.

All this clearly illustrates a very simple but important fact which, if thoroughly understood, can save a lot of trouble: the expansion valve has had nothing to do with the temperatures in the system.

WATER REGULATING VALVE - Adjust the water regulating valve to see if the pressure can be lowered to normal. Check the strainer; it may be clogged. When the valve is working properly it should open when the unit runs, holding a fairly steady pressure, and should close tightly a few minutes after the unit stops. On the larger units with large pilot operated regulating valves, the head pressure will slowly rise and fall over a small range of a few pounds when the unit is running.

DIRTY CONDENSER - In some localities, the water forms a deposit on the walls of the condenser tubes. This deposit grows until it seriously decreases the effectiveness of the condenser, and may even completely stop the tubes. Cleaning is the only remedy.

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PURGING - Air in a system will accumulate at the top of the condenser and will cause the head pressure to be abnormally high. This air can be easily purged by "cracking" the discharge line at the compressor head.

REFRIGERANT CHARGE - Check the refrigerant charge. The magnetic liquid level indicator is the simplest and surest way to determine the refrigerant level. All air-cooled units, and all shell and coil type condensers will be equipped for this device.

A liquid line sight glass is easily connected in the line and will also show whether or not the charge is adequate. A shortage of refrigerant will also usually cause the expansion valve to "hiss" and will show many bubbles in the liquid line sight glass.

On water-cooled units it is advisable to use the level indicator because it is important to carry the liquid level at the height indicated by the arrow on the end of the condenser. Too much refrigerant will cause high head pressure while too little will cause the liquid line to run too warm.

If the charge is low or has been lost find the leak before replacing.

BACK PRESSURE CONTROL - Install a pressure gauge on the compressor suction service valve and watch it through a few cycles.

If the cooling unit is a finned coil, or a blower coil, or even a water cooler, the suction pressure should be above 32 lb. when the control starts the unit. The pressure should drop rapidly until the expansion valve opens and then should pull down slowly until the cutout pressure is reached.

By watching the gauge through several cycles, the following three things can be determined:

1. If the pressure is erratic the expansion valve is probably "surging".
2. If the pressure dropped very rapidly to the cutout valve, it indicates:

Cutout set too high.

Expansion valve not opening.

Cooling unit capacity too low for condensing unit.

Low refrigerant charge.

3. If the pressure dropped very slowly, hanging for a long time just above the cutout value, it indicates:

Cutout set too low.

Condensing unit too small.

Watch the gauge through a few cycles to be sure that it always operates at the same pressure.

If a service call is received on a system that is known to have been operating successfully for some time, do not make any changes in adjustments until you can find a definite reason to do so. Previous satisfactory operation indicates that the controls were adjusted all right. The first conclusion should be to look for loss of refrigerant charge, high head pressure, or defective expansion valve. If every thing seems right, then check the control settings, but if you change them try to

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reason why the change is necessary.

UNLESS YOU FIND OUT WHAT IS CAUSING THE NEED FOR CHANGING ADJUSTMENT ANOTHER CALL BACK WILL RESULT.

COMPRESSOR VALVES - Close the suction service valve on the compressor, block the back pressure control closed and see how low the suction pressure will pull. With good valves the pressure should pull down to about 21-in. vacuum or more. When the compressor is stopped, the pressure will increase slowly because of refrigerant dissolved in the oil in the crankcase. By pumping down several times this refrigerant will be removed and the pressure should hold steady.

If the pressure increases rapidly, even after pumping down several times, both intake and discharge valves are leaking. If the pressure increases only very slowly or holds constant either intake or discharge valves might possibly leak, but not both. If the compressor pumps down to a 21-in. vacuum, probably any leakage existing is not serious.

If in normal operation the compressor will not pull the pressure as low as it should, and the head pressure is below normal, the valves should be inspected. Look particularly for dirt particles holding the valves open, and if any are found, install a suction line strainer.

COOLING UNIT CAPACITY TOO LOW - There are not many things to cause trouble with a cooling unit. First be sure that air circulation is not restricted. The only other possibility is inadequate refrigerant supply to the coil.

EXPANSION VALVES - Crack the flare nut at the expansion valve inlet to be sure that refrigerant is being supplied to it. Occasionally dirt or a kink in the tubing will restrict the flow through the liquid line. This can cause trouble even though the line is not completely stopped up. Any restriction causes a pressure drop and if the liquid pressure drops below that corresponding to its temperature, some of the liquid will vaporize. This vapor has to pass through the expansion valve and decreases the capacity of the valve. There are two usual indications when this happens, the valve will "hiss" and the liquid line will feel cooler than normal. Feel along the liquid line; it will be colder on the valve side of the restricted place than on the other side.

Pump the system down and examine the strainer in the expansion valve inlet. Dirt clogging this strainer would act the same way as a restriction in the liquid line.

Check the location of the bulb on the suction line of the coil. The bulb must be clamped solidly to the tube. The bulb must not be in a place where it may get too cold because this would cause the valve to stay closed too much.

The bulb should not be located where it can become too warm. Here heat from the nearby warm room is conducted along the tubing to the bulb. When the bulb is too warm the valve opens too much and causes refrigerant to flood back. It is not sufficient in this case merely to adjust the valve, because if it is set so it will stay closed during the off cycle it will not open enough during the running cycle.

Too much friction in the valve will show up by "surging" or wide variations in section pressure.

Moisture in the system will freeze at the expansion valve needle and may cause the valve to freeze open or closed or in almost any position. Allowing the system

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to warm up will thaw the ice and allow the valve to work again. Install a drier to remove the moisture, otherwise it will collect again and freeze it.

EXPANSION VALVE ADJUSTMENT - In adjusting an expansion valve, remember that the system must be given time to show the effect of the adjustment. Never turn the adjusting nut more than $1/6$ of a turn at a time and wait several minutes each time to see what happens. As the valve is opened more and more the point will be reached where liquid refrigerant is being carried over into the suction line. The final setting should be just before this happens. It is necessary to check through several complete cycles to be sure that "flood back" does not occur at any time.

SWEATING SUCTION LINE - Sweating of the suction line does not necessarily mean that "flood back" is occurring. In high humidity the normal suction line temperature may be low enough to cause sweating and the only cure is either to install a heat exchanger to warm up the suction vapor, or to insulate the line. Do not adjust the expansion valve to eliminate sweating unless it is really due to "flood back". To do so would reduce the cooling unit capacity.

To summarize expansion valve troubles, there are only four things that can happen:

1. Anything that makes the bulb warmer than it should be can cause "flood back" or if the valve is adjusted to eliminate "flood back", will cause the coil to be "starved".

2. Anything that makes the bulb or the second bellows end of the valve too cold will starve the coil or if readjusted to fill the coil will flood the coil during an off cycle.

3. Moisture can freeze the valve open or closed to cause anything from "flood back" to no refrigeration.

4. The valve can be defective. This will usually be due to the loss of refrigerant charge from the bulb, in which case the valve will not open; or there is too much friction in the valve causing erratic operation. Defective valves should be replaced.

The following directions have been compiled for the express purpose of simplifying the serviceman's problems of servicing and repairing water coolers.

These instructions are separated into eight principal headings which are in turn broken down into systematic steps of procedure which can be followed separately as necessary or completely from step 1 through step 30e.

It is not intended that these steps be memorized but rather as an outline of procedure to assist the serviceman in gaining the proper experience. A certain amount of practice is necessary for the serviceman to overcome the feeling that he is doing too much or too little, particularly with respect to opening and closing the valves at the proper time.

Practice is the only method by which a serviceman can adapt himself to this procedure and he could read and attempt to absorb all the material ever written on the subject and still lack the necessary sense of feel which goes hand in hand with service of refrigeration equipment. As a serviceman, he is familiar with this sense as it is necessary to a greater or lesser extent in the successful handling of practically every job he undertakes.

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Knowing the basic principles of operation of the mechanical refrigeration system makes every one of the steps outlined a matter of common sense if one will but stop to analyze the entire procedure. If this is done, memorizing is not necessary.

OPERATIONS FOR PUMPING DOWN SYSTEM

1. Install compound gauge on suction service valve and turn valve $\frac{1}{4}$ turn from back seat position.

2. Front seat the liquid line valve. This valve is to be found on side of or attached to condenser.

3. Start compressor. When the compressor pulls the refrigerant pressure down to the low pressure cut out valve, the motor will shut off. Then, as the gas is liberated from the oil in the system, the back pressure will build up, increasing to the point where the motor will start again. This may happen 3 or 4 times, during which the period of time that the motor is idle will increase and the length of the running period will decrease, the running period being only a few seconds. It is not necessary to allow this to happen if time is a factor. When the pressure has been pulled down to the pressure of automatic cut-out of the low pressure switch, operation 3a and 4 can immediately be executed in order.

3a. Open line switch.

4. Block low pressure cut-out switch closed. By closing and opening line switch, operate compressor to where the reading on the gauge shows 0 pounds pressure or a slight vacuum. This is to eliminate most of the gas that is in the oil in the crankcase of the compressor.

5. Check to see that the line switch is open.

6. Front seat suction service valve. (on side of compressor)

After operations 1-6 inclusive have been completed, the refrigerant is confined between the suction service valve and the liquid line valve, which permits working on any part of the system between these points, such as the expansion valve.

COMPLETE PUMP-DOWN

7. Front seat the discharge service valve (on top of compressor) and then back it off 1 turn.

8. By quickly closing and opening the line switch, let the compressor make 2 or 3 revolutions.

9. Quickly and completely front seat discharge service valve.

Operations from 7-9 inclusive eliminate the refrigerant between the suction service valve and the discharge service valve and permit working on the compressor or any part of the system between the liquid service valve and the discharge service valve. Operations 1-9 inclusive to give all the procedure necessary to follow when a unit is to be shut down for long periods, such as in winter.

WHEN REMOVING THE COMPRESSOR OR CYLINDER HEAD BE SURE TO UNBOLT THE VALVES FROM THE COMPRESSOR TAKING CARE NOT TO DISCONNECT THE TUBING FROM THE VALVES.

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OPERATIONS FOR STARTING SYSTEM AFTER IT HAS BEEN PUMPED DOWN AND HAS NOT BEEN OPENED TO THE AIR.

- 1a. Back seat discharge service valve.
- 2a. Turn suction service valve 1 turn from its front seat position.
- 3a. Turn liquid line valve 1 turn from its front seat position.
- 4a. Turn compressor 2 or 3 revolutions *BY HAND*.
- 5a. Inspect for leaks.
- 6a. Check oil level in compressor.
- 7a. Back seat completely the suction service valve.
- 8a. Close line switch.
- 9a. Then over a period of 5 or 6 minutes, gradually back seat the liquid line valve.

IF THE COMPRESSOR HAS BEEN REMOVED FROM CONDENSING UNIT, OR IF THE COMPRESSOR HAS BEEN OPEN TO THE AIR AFTER BEING PUMPED DOWN AS IN OPERATIONS 1-9 INCLUSIVE, PROCEED AS FOLLOWS:

- 1b. Fasten and bolt securely the suction and discharge service valves.
 - 2b. Remove the plug from the discharge service valve.
 - 3b. Turn on motor. This pumps a vacuum on the air trapped in the compressor, the air exhausting from the unplugged discharge service valve. In 2 or 3 minutes the air will be removed. To insure removal of humidity, let compressor run for 30 minutes.
- DO NOT TURN ON COMPRESSOR UNLESS THE PLUG IN THE DISCHARGE SERVICE VALVE IS COMPLETELY REMOVED AND THE SERVICE VALVE IS FRONT SEATED.*
- 4b. Crack liquid line valve and suction service valve.
 - 5b. Shut off motor at once so that the compressor does not run and let the pressure through the system from the cracked liquid line and suction valves flow out through the unplugged discharge service valve for a few seconds.
 - 6b. Crack suction service valve about $\frac{1}{4}$ turn from its front seat position. Be sure the suction service valve is opened far enough to admit gas to compressor. This will be evident by a difference in the sound of the compressor as the gas passes into it. The gas immediately begins to blow out of discharge service valve into the air.
 - 7b. While gas is blowing out of discharge service valve, replace the plug and tighten securely.
 - 8b. Back seat discharge service valve.
 - 9b. Start compressor and slowly back seat the suction service valve.

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10b. Over a period of 5 or 6 minutes, gradually and completely back seat liquid line valve.

THE FOLLOWING IS PROCEDURE FOR REMOVAL AND REPLACEMENT OF THE EXPANSION VALVE:

1c. Pump-down as in operations 1 to 6 inclusive.

2c. Remove the old expansion valve and replace with a new one, leaving the connection where the valve is fastened to the evaporator cooling coils $\frac{1}{2}$ turn loose.

3c. Crack the liquid line valve.

4c. Immediately crack the discharge and suction service valves from their front seat positions. This permits refrigerant to go both ways through the system to the cracked connection between the expansion valve and evaporator, driving out the air and any small amount of moisture that entered the system when the new expansion valve was installed.

5c. After about 20 seconds, tighten connection at the evaporator.

6c. Completely back seat discharge service valve.

7c. Back seat the suction service valve.

8c. Start compressor.

9c. Over a period of 5 or 6 minutes gradually and completely back seat liquid line valve.

TO WORK ON THE CONDENSER IF ANY OR ALL REFRIGERANT IS IN THE SYSTEM.

1d. Open line switch.

2d. As a reminder -- All service valves are now in the back seat position, or in other words, in their normal position for operation of the unit.

3d. Remove the plug from the discharge service valve.

4d. Connect an empty refrigerant drum or one partially filled but with enough room in it to accommodate the charge, to the connection from which the plug was removed in step 3d. Leave the connection $\frac{1}{2}$ turn loose. The drum should be lower than the discharge valve on the compressor and setting upright with valve at the top so that the liquid refrigerant will not enter the system.

5d. Crack the valve on the drum.

6d. Tighten the connection that was left $\frac{1}{2}$ turn loose after refrigerant has escaped 5 or 6 seconds to expel air from connecting tubing.

7d. Front seat the discharge service valve.

8d. Open the drum valve 4 or 5 turns.

9d. Start the compressor.

10d. It may be necessary to cool the drum by placing in a pan of cold water or

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by covering the drum with cloths dipped in cold water, as the refrigerant being pumped and compressed into the drum will heat it.

11d. When the low pressure cut-out opens and the gauge on the suction service valve shows nearly 0 pounds pressure, then the refrigerant is practically all out of the system and in the drum. The suction service valve gauge can show nearly 0 pounds pressure *ONLY* if the drum which is receiving the gaseous refrigerant has been kept cold enough to permit condensation of the refrigerant. If the refrigerant passing into the drum has been allowed to heat it, it will be impossible to pull a 0 pounds pressure at the suction gauge connection. The colder the drum, the quicker will be the operation of pumping all of the refrigerant out of the circuit and the more complete will be this operation.

12d. Front seat the liquid line valve.

13d. Stop compressor.

14d. Close the valve on the drum.

15d. Front seat the suction service valve.

16d. Disconnect the plug in the discharge service valve.

17d. Replace the plug in the discharge service valve.

18d. Any part of the condensing unit may now be opened. Some refrigerant will still escape since it is not possible to get the last traces into the drum.

PROCEDURE FOR ADDING REFRIGERANT TO THE SYSTEM

1e. Tighten all connections that have been disconnected to permit replacing parts.

2e. Remove the plug from the discharge service valve.

3e. Connect the drum of refrigerant to suction service valve at the service connection. The drum should be placed on scales or be suspended in some manner to facilitate weighing of the refrigerant. The drum should be in a position with its upper or valve end vertically upward so that in carrying out operation liquid refrigerant will not be sucked into the compressor with possible damage to the leaf or intake valve located immediately behind the suction service valve.

4e. Set the suction service valve midway between front and back seat positions.

5e. Front seat liquid service valve.

6e. Front seat discharge service valve tightly. (This valve may already be front seated as this is the position last used when removing the refrigerant.) (Operation 6d)

7e. Start the compressor and let it run from 1/2 to 3/4 of an hour. A vacuum will be pulled in a minute or less but continued running for half to 3/4 hour will purge out moisture which may be introduced if the system has been open any length of time. Air will be pumped from the entire system, including that in the connection between the drum and the suction service valve, thru the unplugged discharge service valve. If a vacuum cannot be pulled in the amount of 26 or 27 inches, there are

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leaks in the system or abnormal looseness of pistons in the cylinders, due to wear or some conditions which have caused a leakage path. Scored leaf inlet or outlet valves may cause this condition.

8e. If a compound gauge can be installed at the suction service valve along with the drum, the gauge will indicate the amount of vacuum being pulled, which should reach 26 or 27 inches. If this amount of vacuum is not reached there may be external leaks into the system which may be detected in the following steps.

9e. Open line switch.

10e. Insert the plug into the discharge service valve and tighten securely. *If this is done*, the vacuum in the system will pull the air back through this valve into the system, if the leaf type outlet valve leaks even so little as to normally be of no consequence, destroying the possibility of checking for external leaks.

11e. Immediately and completely tighten the plug in the discharge service valve.

12e. Watch the compound gauge for 5 to 10 minutes to see if the system holds its vacuum. If it holds within 1 inch it can be assumed there are no leaks.

13e. Remove the plug from the discharge service valve.

14e. Close the line switch.

15e. Pump vacuum for another 5 minutes especially if the vacuum has dropped any during the standing period.

16e. Start the plug into the discharge service valve 1 turn.

17e. Open line switch.

18e. Crack the drum valve. The refrigerant will start to flow from the discharge service valve thru the loose plug.

19e. The compound gauge will climb to a 0 lbs. pressure or even higher, and when it does immediately proceed with 20e.

20e. Tighten the discharge service valve plug.

21e. Back seat the discharge service valve.

22e. Start compressor and keep running thru step 22e to 30e inclusive. (Close line switch)

23e. Open the drum valve that has been cracked. Throttle this valve so that pressure does not build up above 40 pounds as read on suction service compound gauge.

24e. The drum will get cold during this operating and the pressure may be so low as to open low pressure cut-out. If this happens, or the pressure falls off, heat the drum.

25e. On TX coolers 11 pounds of refrigerant should be added and 4 pounds on the WX cooler. (*Provided that there was none in the system.*)

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26e. Close the drum valve.

27e. Back seat the suction service valve.

28e. Back seat the liquid line valve. The condensing unit should start to operate at normal conditions, that is, it will operate until it has cooled down, whatever there is to cool from contact with the evaporator, after which it should start to cycle normally.

29e. Disconnect the drum from the suction service valve.

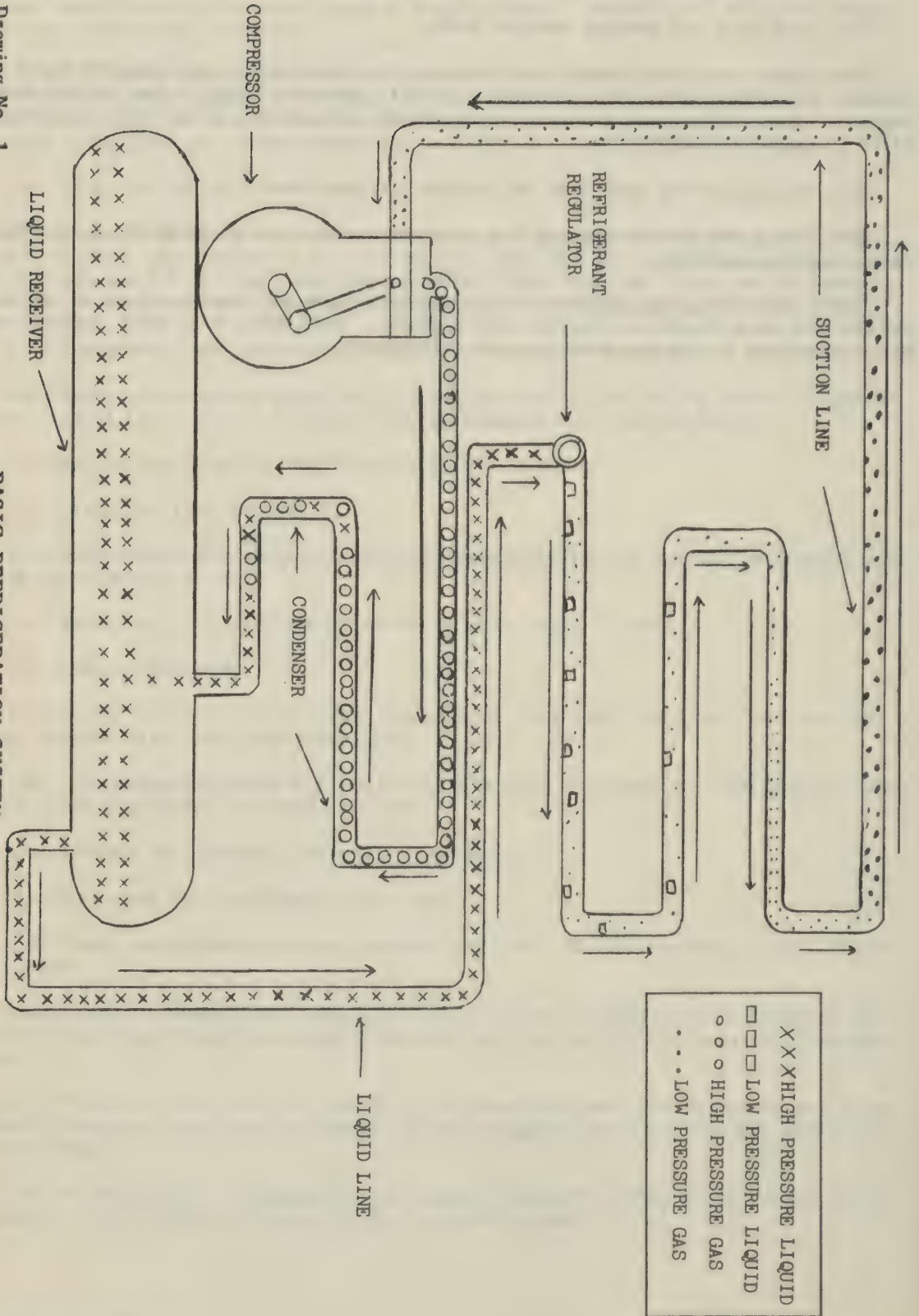
30e. Plug the connection on the suction service valve from which the drum connection was removed.

NOTE--When plugging service connections or valves and capping stems or service valves, be sure these are sealed very tightly. Otherwise very slow leakage may occur resulting in the eventual loss of refrigerant.

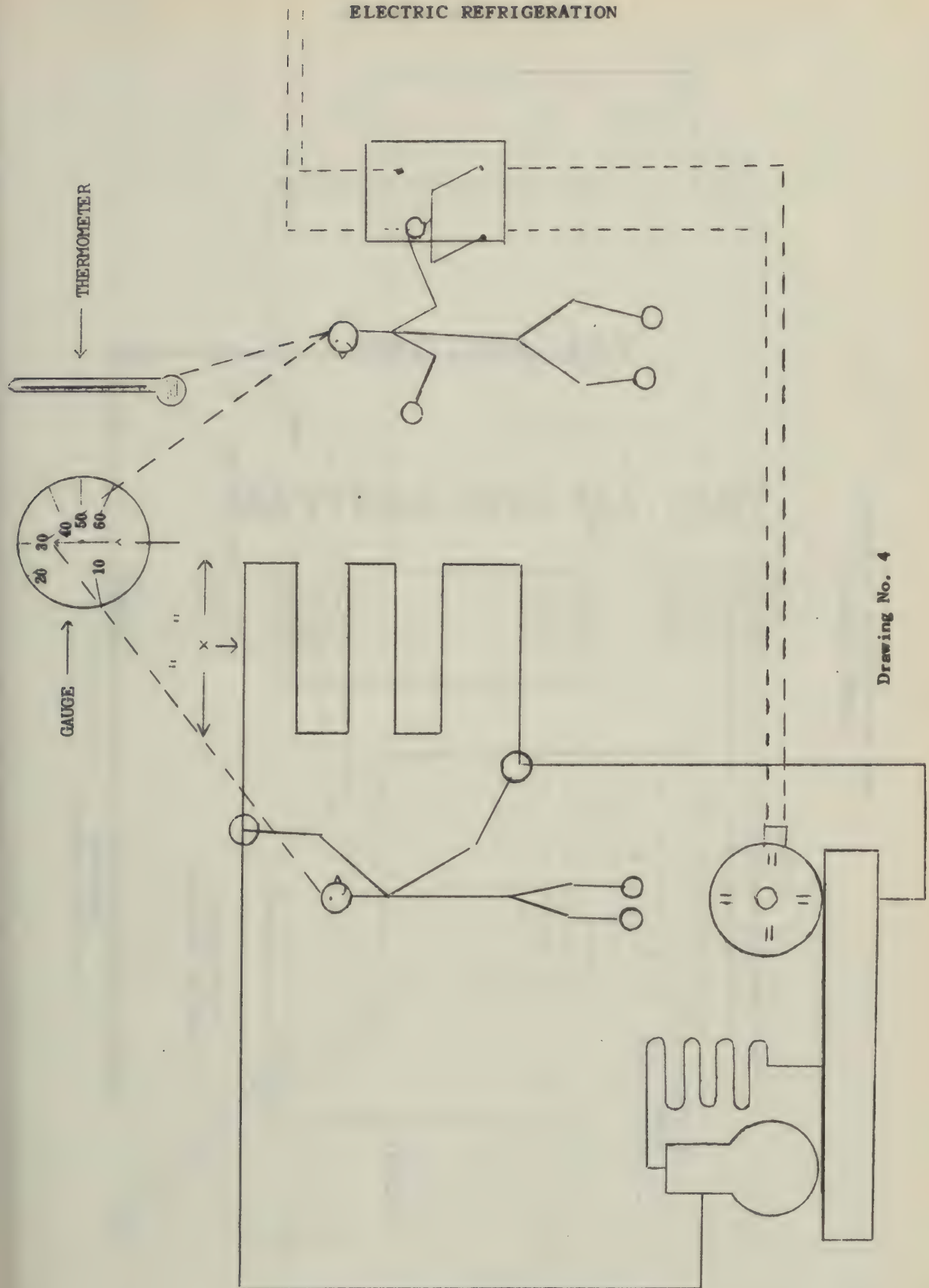
ELECTRIC REFRIGERATION

Drawing No. 1

BASIC REFRIGERATION SYSTEM



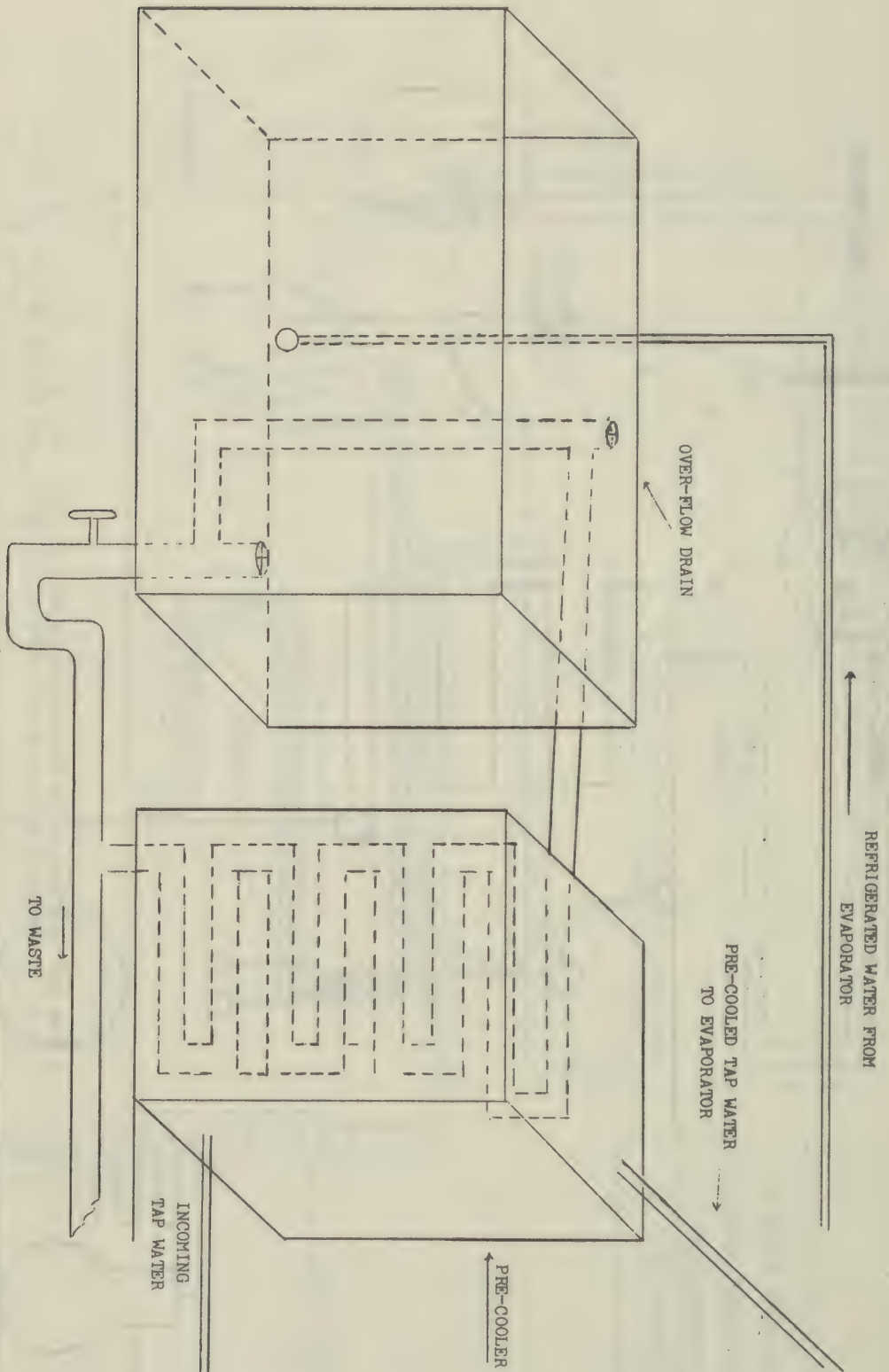
ELECTRIC REFRIGERATION



Drawing No. 4

ELECTRIC REFRIGERATION

SCHEMATIC DRAWING
PRE-COOLER AND DEVELOPING TANK



SECTION LVI

MATTERN 200 MA UNIT

SECTION LVI

MATTEN 300 MA UNIT

MATTERN 200 MA UNIT

GENERAL POWER AND LINE REQUIREMENTS

To insure maximum service and satisfactory performance, it is of considerable importance that the power source be adequate and stable.

The Standard Control Unit is designed to operate under the following conditions:-

200 to 260 Line Volts

100 Ampere supply with not more than two percent line drop at the Control Switch when the load is maximum.

These conditions are satisfactorily met when a separate 25 K.V.A. power transformer is used as a supply with not over 100 feet of No. 2 (or larger) A.W.G. supply line terminating at a 100 ampere fused switch box located within the room to be occupied by the control unit.

Where longer runs are encountered, increase one wire gauge size for each additional fifty feet. Where line volts under 208 volts are encountered, increase one wire gauge size.

NOTE: Your local power engineer should be consulted concerning these conditions and requirements.

GROUNDING - Unstable operation of the machine is likely to be encountered unless it is well grounded. Water or steam pipe grounding with the shortest possible run of #6 or #8 is recommended in addition to ground supplied at the switch box, especially where other than ground floor installations are made.

WIRING

ROOM LIGHT - The Control Unit is wired to supply 110 Volts with Footswitch Control to a fluoroscopic Room Light.

The wiring for this Room Light should be independent of the 'house' circuit and brought out to the male receptacle (motor plug) at a point in the wall convenient to the Control Stand and terminating at the two 'RL' terminals inside of the Control Stand.

UNPACKING

In order to prevent destruction of the crates the larger ones may be opened by removing all the wood screws. Each screw to be removed is indicated by a circle.

Carefully remove lashings and protective paper. If any boxes are broken or show signs of mishandling during transit do not proceed further but notify the Medical Supply or other responsible officer.

Thoroughly wipe and clean all parts to remove dust and protective coating.

DO NOT DESTROY PACKING MATERIALS UNTIL THE MACHINE IS COMPLETELY ASSEMBLED AND ALL PARTS ARE LOCATED IN THEIR PROPER PLACE.

ASSEMBLY PROCEDURE - The general procedure recommended for assembly of the unit is as follows:

MATTERN 200 MA UNIT

1. Set Motor Table in position.
2. Set Vertical Rails in position.
3. Set High-Tension Transformer in place and fill with oil.
4. Assemble Motor Table Weights, Screen Carriage and Fluoroscopic Tube and make leveling adjustments on Table.
5. Make final adjustment of Vertical Side Rails relative to Motor Table and screw rail brackets to floor.
6. Assemble Vertical Tube Stand to Side Rails.
7. Assemble Radiographic Tube and Cables.
8. Put Control Stand in position and make Power Cable connection.

MOTOR TABLE ASSEMBLY

The Motor Table is shipped less its counterweights, fluoroscopic screen and tube. The bucky and screen carriage counterweights are lashed to a brace and locked in place to prevent shifting in transit. Remove the brace and locks which are indicated by tags. The table counterweights are assembled as shown in diagram #5278.

To assemble the fluoroscopic screen frame, remove the two ornamental knockout plugs from the ends of the carriage rods and mount the support arm so that both clamps fit flush with the end of the rods. Replace the knockout plugs.

The motor extension cord plug location is shown on diagram #5318. Supply voltage required is 110 volts, 60 cycles.

Shutter Control cables should be assembled before the fluoroscopic tube is put in place. The table should be raised to approximately 60 degrees, which makes the shutter frame and arms accessible from the underside of the table. Assemble the control cables as indicated in diagram #5271.

Leveling adjustments should be made with a spirit level and the leveling screw shown in diagram #5318 and with the table in its level position as indicated in the scale. Proper leveling is essential to assure quiet operation and minimize wear on motor drive mechanism.

VERTICAL TUBE STAND

A wood block is placed inside the tube column which holds the counterweight at the top of the tube column during shipment. Care should be exercised when removing it and allowing the tube arm to rise to the top of the tube column.

The stereo shift counterweight should be assembled to the top of the stereo bar.

RADIOGRAPHIC TUBE ASSEMBLY

To assemble Radiographic Tube, it is unnecessary to remove any screws or parts from the tube stand.

1. Remove mounting screws located on the window face of the x-ray tube.
2. Lower tube carriage to about table height and *lock firmly*.
3. Place the x-ray tube on the tube mount assembly and assemble with mounting screws.
4. If tube is equipped with a blower, attach blower power cables to terminals CH and RH on the transformer as indicated on the cable end lugs.

MATTERN 200 MA UNIT

POWER CABLE CONNECTIONS - All lugs on cable ends and terminals are stamped for identification. Symbols should be followed in preference to any color code found on the wires.

Line Power Cable: LL, G, LX. LL and LX should connect to 220 Volt supply line at main switch box. G should be connected to a good ground terminal.

Transformer Power Cable: P, CP, G, F, SF, LF, VF, VF, SI, SS.

High-Tension Switch Cable: CH, RF, FH.

Bucky Supply Cable: 110, MR, BC.

HIGH-TENSION CABLE CONNECTIONS - All shockproof high-tension cable connectors should be carefully cleaned and packed with white vaseline. This is particularly important where high humidity is encountered or where installation is made at high altitudes.

VERTICAL SIDE RAILS - The Vertical Side Rails may be secured to the floor by means of wood or lag screws or by means of the Ackerman screws provided. To insure proper alignment of tube with respect to the table and bucky, it is important that the locating dimensions shown on diagram #5318 are held closely. Leveling plates are provided on the Rail Support.

HIGH-TENSION TRANSFORMER

In some instances, the high-voltage transformer oil is shipped separately. The oil may be replaced either by removing the vent plug and the use of a funnel or by raising the entire transformer by means of the elevating mechanism.

When filling the transformer, see that no oil is allowed to spill on the rubber line cable, rubber composition floors, etc.

At normal room temperatures, 60 degrees - 70 degrees, the tank should be filled to within 3/4" to 1" of the underside of the top.

When using the elevating mechanism the procedure is as follows:

1. Remove the power cable terminal cover and the trim ring by removing the 22 ornamental nuts and washers.
2. Raise transformer assembly by clockwise rotation of crank to a height of 13 1/2". This height is indicated by the *red line* on the *transformer core frame*. Use care to see that no dust, water or packing material fragments are allowed in the oil.
3. Check the valve tubes to make certain they are properly clipped in position.
4. Fill the tank with oil to the level indicated by the *red line* on the *inside of the tank*. Use care to see that no dust, water or packing material fragments are allowed in the oil.
5. Lower the transformer and replace trim strip.
6. Remove small vent screw in the 1/4" pipe plug after transformer is in *permanent position* to allow for oil expansion.

THIS IS IMPORTANT

ALLOW 18 TO 24 HOURS AFTER FILLING BEFORE ENERGIZING THE HIGH-VOLTAGE WINDING OF THE TRANSFORMER.

OIL IMMERSSED CONTACTOR - The oil immersed contactor is located on the control stand floor at the rear left hand side. Remove the 1/8" pipe plug found in the bakelite top to allow for expansion.

ASSEMBLY OF TABLE COUNTERWEIGHTS

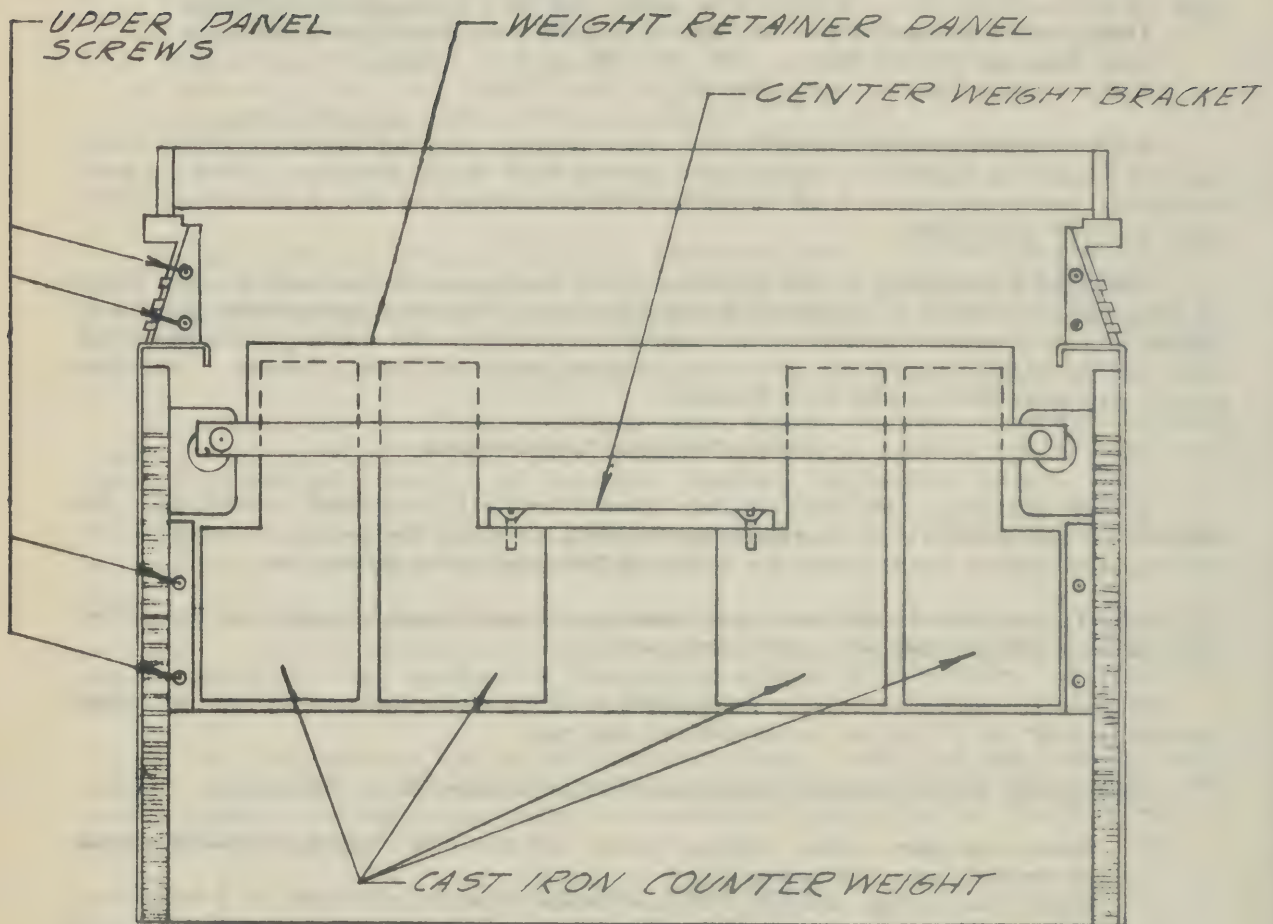


Diagram #5278

1. Remove the upper end panel which is held in place by the eight thin round head screws.
2. Remove weight retainer panel.
3. Insert cast iron weight in portions shown. The flange on the weights should fit into the channel at the rear of the shelf.
4. Attach center weight bracket.
5. Replace weight retainer panel and upper panel.

MATTERN 200 MA UNIT

INSTALLATION ASSEMBLY - G-1319-F

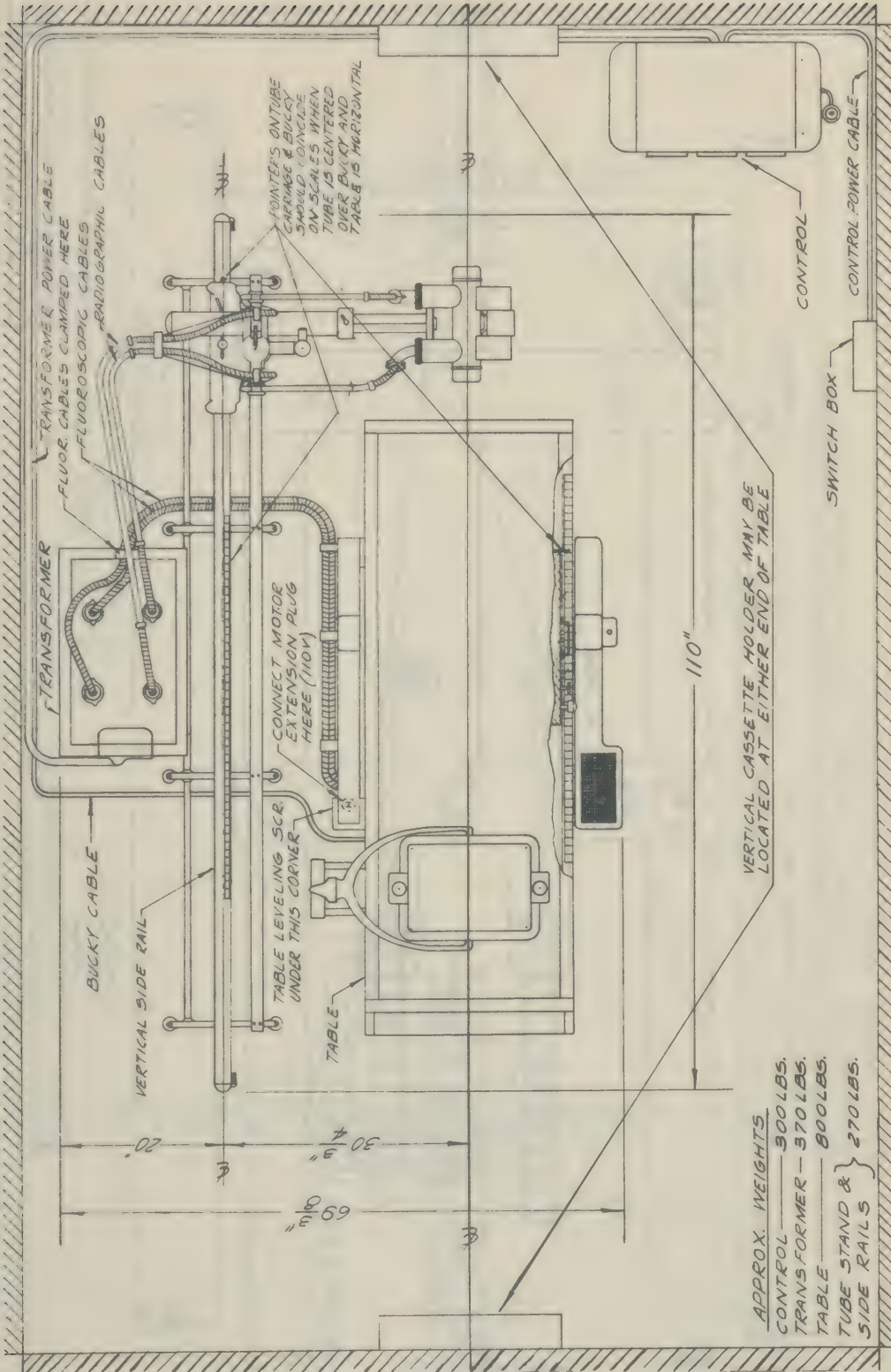


Diagram #5318

AMT.	USED ON	DRG. NO.

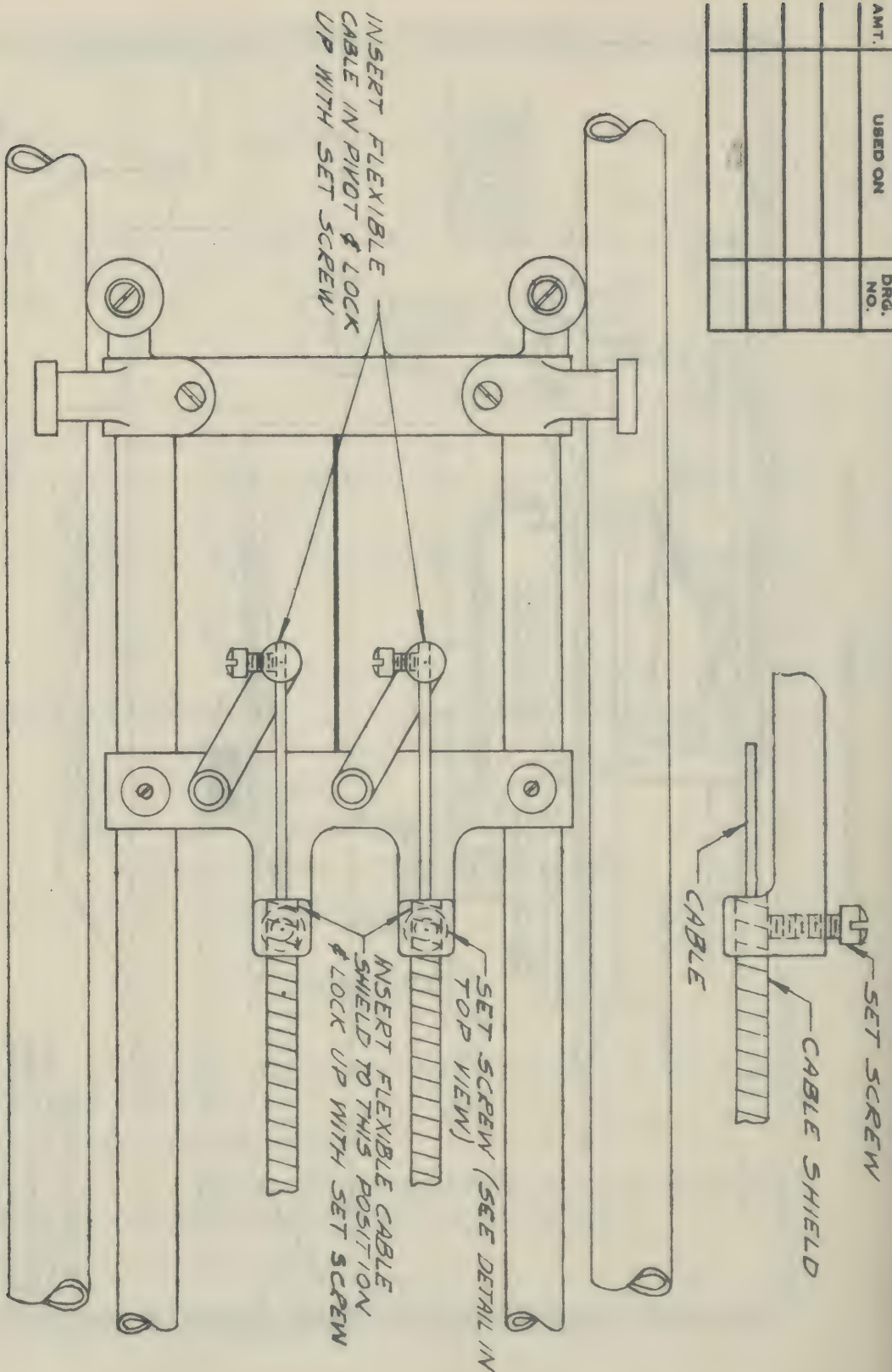
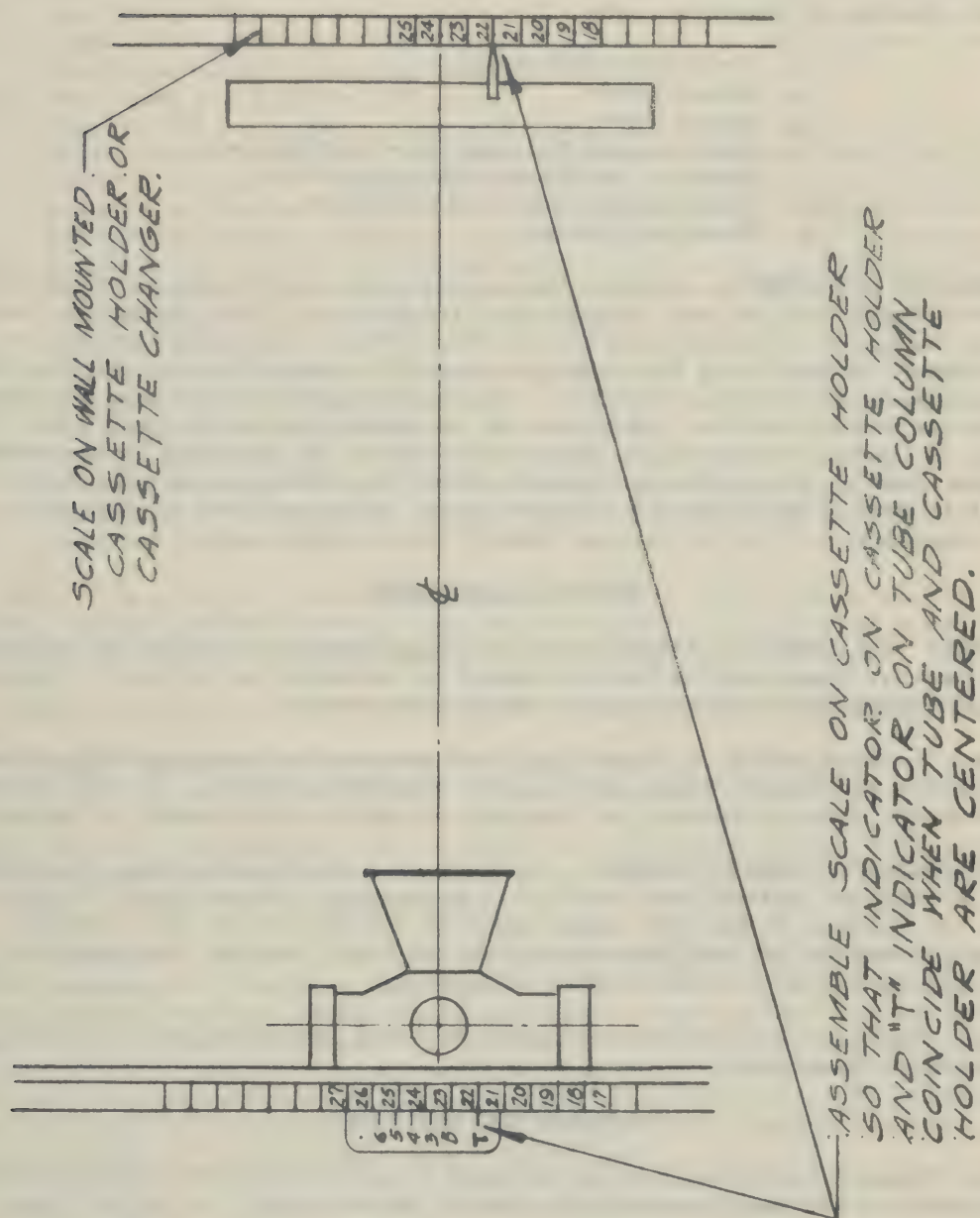


Diagram #5271

VERTICAL CASSETTE HOLDER ASSEMBLY



ASSEMBLE SCALE ON CASSETTE HOLDER
SO THAT INDICATOR ON CASSETTE HOLDER
AND "T" INDICATOR ON TUBE COLUMN
COINCIDE WHEN TUBE AND CASSETTE
HOLDER ARE CENTERED.

Diagram # 5285

MATTERN 200 MA UNIT

PRELIMINARY TESTS - Preliminary tests may be made using 10 or 15 ampere fuses in the main switch box in place of the regular 60 or 100. However, this is not essential if all connections made on installation are standard and are carefully checked before attempting to operate the unit.

TESTING AND ADJUSTMENTS - Before the Unit is ready for use, the following test and adjustments should be made:

- a. Set Correct Line Tap.
- b. Adjust Meters.
- c. Adjust Timer.
- d. Check or make Filament Meter Calibration.
- e. Check or set Filament Regulator Stops.
- f. Check Circuit Breaker Adjustments.
- g. Check Calibration.

LINE TAP ADJUSTMENTS - Before closing the main switch, the Autotransformer Adjustable taps should be set to match the line voltage. This adjustable lead is found on the upper left hand side of the Main Terminal Board in the rear of the Control Stand. Selection of the proper tap should be made after a twenty-four hour line voltage check is made on the line, and should depend not only on the average Line Voltage encountered but the *extent of variation* during the twenty-four hour period. The panel mounted Line Compensator Switch is designed to accommodate variations from 10 volts below to 20 volts above the voltage designated by the tap terminal in such a way as to maintain the proper volts per turn on the autotransformer regardless of line variations within this 30 volt range.

METER ADJUSTMENTS

"ZERO" ADJUSTMENTS - After the unit is completely assembled and all wiring connections are completed, all meters should be correctly set at their respective "zero" positions before attempting to operate the machine.

When the main switch is closed, the line compensator meter should be adjusted to the center red line by means of the line compensator switch. If this cannot be done, a major line adjustment at the rear of the control stand is indicated.

SYNCHRONOUS TIMER ADJUSTMENT - Although the Synchronous Timer is adjusted before leaving the factory, when additional adjustments are necessary, it should be checked for accuracy at the 1/20 second position and adjusted on that position. The adjustment screw may be found protruding from the Timer Cover on the upper left hand side. Turning to *right increases* time of exposure.

The 'Spin-Top' or similar method of checking should be used; allowing six impulses for 1/20 second.

FILAMENT CALIBRATIONS

The Filament Control Circuit is designed to provide automatic MA selection as is indicated on the panel mounted MA selector control.

A Vernier Filament Regulator Control is provided on the front panel which, when used with the Filament Meter, provides precise final adjustment of the x-ray tube filament where extreme accuracy is desired.

When making the filament calibration, the heaviest load to be used, i.e., 200 MA should be set first.

MATTERN 200 MA UNIT

Procedure is as follows:

1. Set Circuit Selector Switch in "Radiographic" position.
2. Set MA Selector Switch in 200 MA position. This places MA meter on 0-250 scale as indicated on the light below the meter (See description of controls).
3. Set PKV at 50.
4. Close line switch and allow at least one minute for the filament circuit to reach its normal operating temperature.
5. Set Timer for 1/20 or 1/10 sec.
6. Depress MAS Scale, thus placing the Ballistic Meter in the circuit and by making trial "exposures" increase the Vernier Filament Regulator Control until a reading of 10 milliamperes seconds (or 20 if using 1/10 sec.) is reached on the Ballistic Scale, USING CARE NOT TO OVERHEAT X-RAY TUBE. Record the Filament reading required to produce this milliammeter load.
7. Set MA Selector Switch to 150 MA position, the timer to 1/10 second, and by trial "exposure" determine and record filament meter setting required for 15 milliamperes seconds. This should require only a minor adjustment of the Vernier Control.
8. Repeat above procedure for the 100 MA setting, using 1/10 sec. and 10 MAS.
9. A similar calibration may be made for 50, 25 and 5 MA settings using the milliamperes scales in place of the ballistic.
10. Similar calibrations may be made for the fluoroscopic tube by setting the Circuit Selector Switch to "Spot Rad" position and setting the Spot Radiographic Filament Regulator to its minimum position so that the switch attached to this control will "click" out.

NOTE: On units not equipped with a Ballistic Milliamperes Second Meter, the 200, 150 and 100 MA settings may be obtained by using the MA Meter if EXTREME CARE IS USED TO PREVENT DAMAGE TO THE X-RAY TUBE.

CONSULT YOUR X-RAY TUBE RATING CHART BEFORE MAKING THIS CALIBRATION.

FILAMENT REGULATOR STOPS - To safeguard against accidentally overloading the x-ray tube by setting the Vernier Filament Regulator too high, stops are provided which should be set to limit the maximum current at any position of the MA Selector Switch to approximately 10% above the indicated amount. The stops are factory adjusted and should not require readjustment unless a different type of x-ray tube is used. See diagram #5078.

CALIBRATION - Since no single method of Radiographic Calibration is universally recognized, provisions for adjusting the PKV output over a generous range are furnished by means of multi-tapped compensator winding, the taps of which are brought out to a terminal board in the lower section of the control stand. A selection of three positions is provided for each MA Selector Switch setting: low, normal and high, as indicated on the terminals. The normal position is based on a sphere gap calibration made at the tube head using regular shockproof cable. Moving the taps to left or 'low' position lowers PKV output.

DESCRIPTION OF CONTROLS - (Refer to diagram #5169-A).

These controls are described in the order in which they are normally used in operating the unit.

CIRCUIT SELECTOR - The Circuit Selector (B-9) is a six position control providing means for automatically selecting the proper x-ray control circuits for

FILAMENT REGULATOR

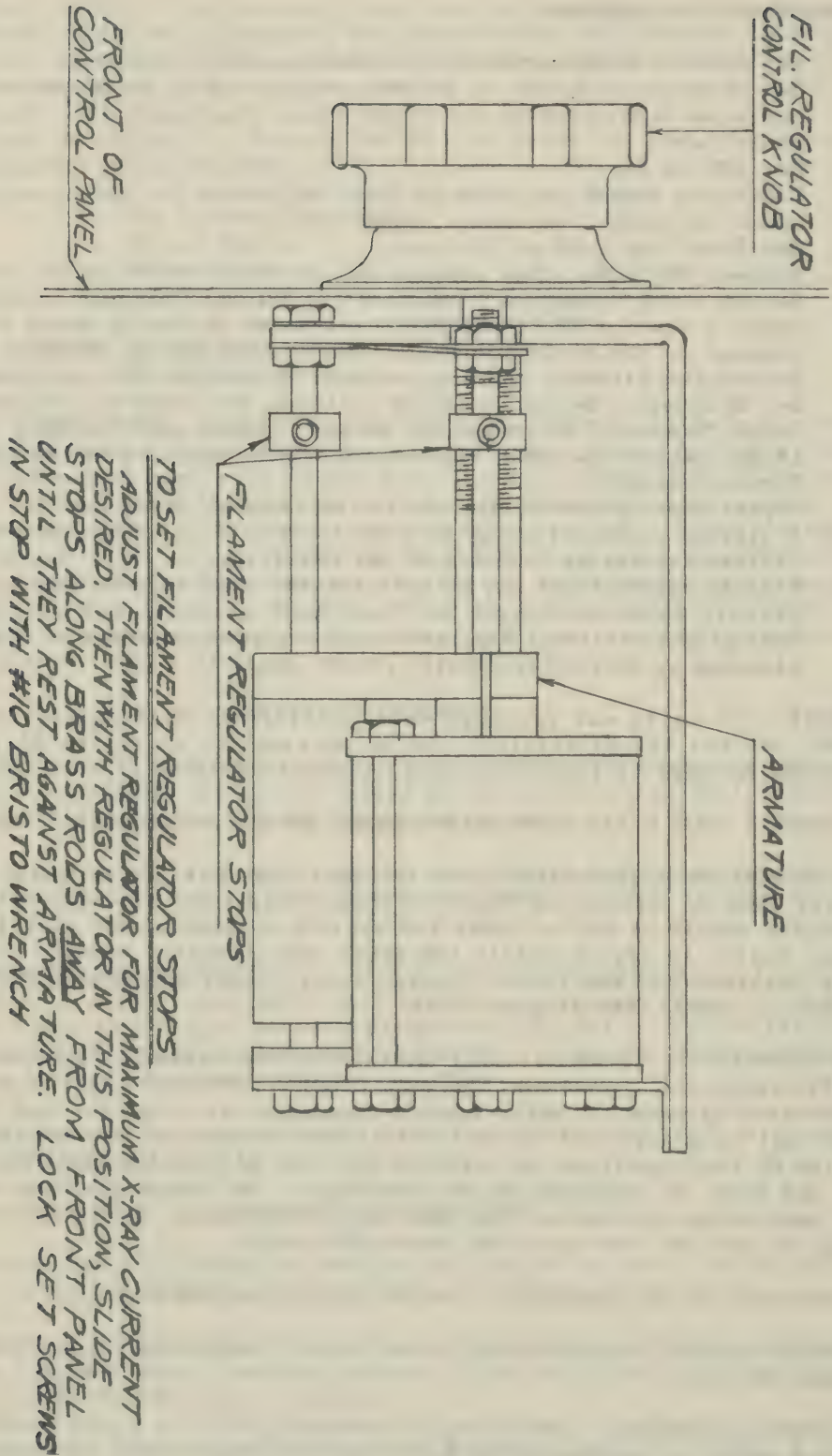


Diagram #5078

CIRCUIT BREAKER ADJUSTMENTS
#5 AND #11 CONTROLS

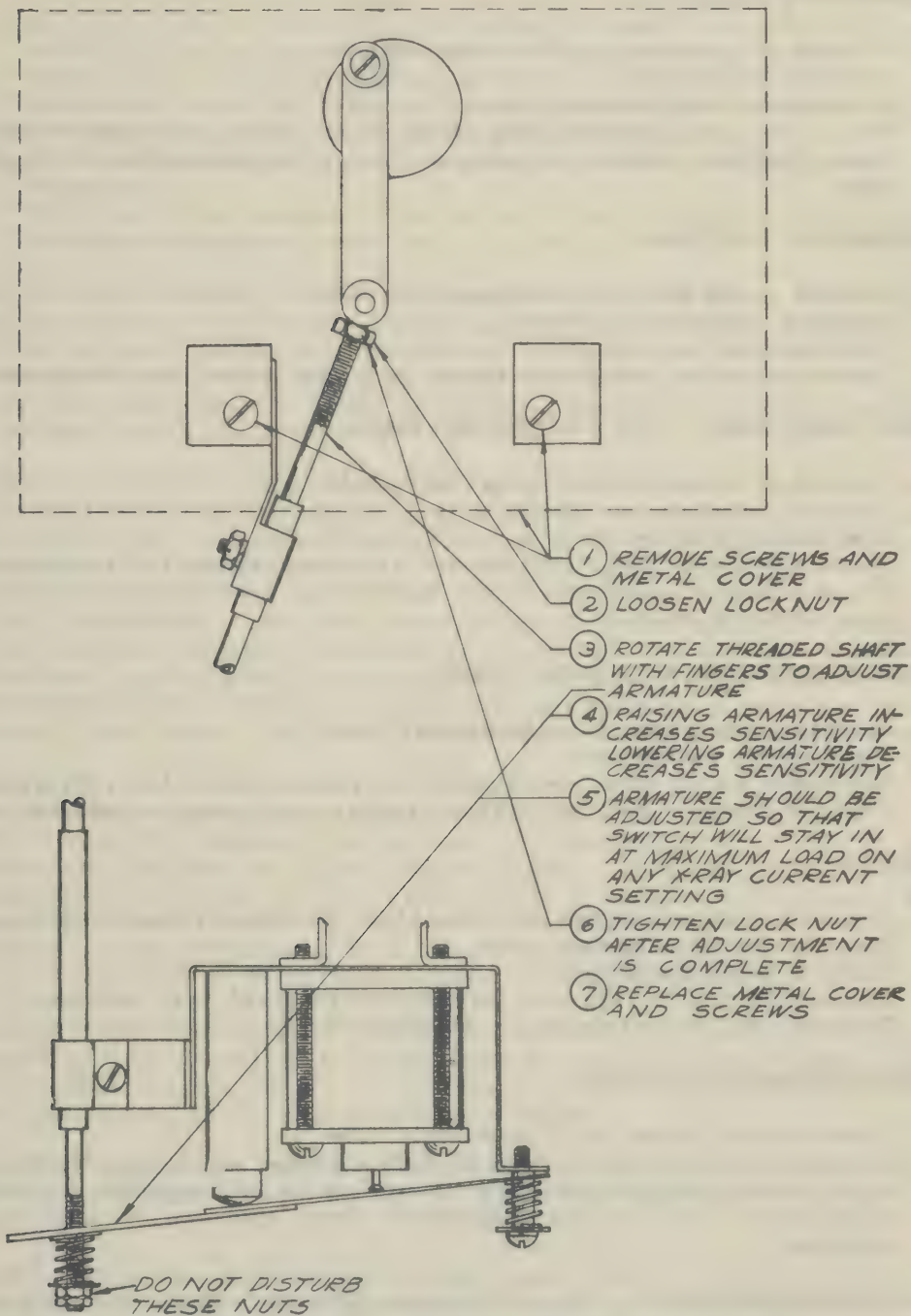


Diagram #5171

MATTERN 200 MA UNIT

Fluoroscopy, Radiography and Therapy. It serves the following functions as shown on the indicator (B-15):

FLUOROSCOPY POSITION:

1. Directs x-ray power to fluoroscopic tube.
2. Connects footswitch.
3. Disconnects synchronous timer.
4. Sets valve tube temperatures (when valve tubes are used) to low value.
5. Places ballast resistor in primary circuit for protection of fluoroscopic tube.

RADIOGRAPHY POSITION:

1. Directs x-ray power to radiographic tube.
2. Connects synchronous timer.
3. Disconnects footswitch.
4. Increases valve tube temperatures to proper value for radiography.

BUCKY RADIOGRAPHY WITH SYNCHRONOUS TIMER:

1. Directs x-ray power to radiographic tube.
2. Connects synchronous timer.
3. Disconnects footswitch.
4. Increases valve tube temperatures to proper value for radiography.
5. Connects bucky interlock so that synchronous timer may be used to control time of bucky exposure.

BUCKY RADIOGRAPHY WITH BUCKY TIMER:

1. Directs x-ray power to radiographic tube.
2. Disconnects footswitch.
3. Increases valve tube temperatures to proper value for radiography.
4. Connects bucky timer in control circuit for timing exposures.

THERAPY:

1. Connects footswitch and any auxiliary therapy timing device supplied.
2. Disconnects synchronous timer.
3. Selects large focal spot.
4. Connects any auxiliary cooling devices supplied with equipment.
5. Connects ballast resistor in primary circuit.

SPOT RADIOGRAPHY POSITION:

1. Directs x-ray power to fluoroscopic tube.
2. Connects spot device circuit in such a manner as to provide fluoroscopy with footswitch and automatic switching to radiographic values on the fluoroscopic tube including automatic focal spot changes when using high MA value.

MILLIAMPERE SELECTOR - The milliamperes Selector (B-6) is also a six position control as shown on the indicator (B-18). Turning to right or clockwise steps to higher milliamperes. This control serves the following functions:

1. Automatically sets the x-ray tube filament temperature to the indicated milliamperes output.

MATTERN 200 MA UNIT

2. Accurately corrects the kilovoltage calibration for the indicated milliamperage setting.
3. Selects the proper x-ray tube focal spot to give maximum definition consistent with the load rating of the tube. For a small "B" (2.3 m/m) focal spot up to and including 50 milliamperes is used. For a large "D" (4.2 m/m) or "E" (5.0 m/m) focal spot 100 milliamperes and up is used. The focal spot in use is shown by indicator (B-27).
4. Selects the proper milliammeter scale (B-3) for most convenient reading and indicates the scale being used by Indicator (B-25).
5. Adjusts the sensitivity of the circuit breaker to conform with the load being used.
6. Disconnects the footswitch for values higher than 5 MA, and automatically connects synchronous timer for 25 MA and up.

KILOVOLTAGE CONTROL - Dual controls (B-4) and (B-5) in conjunction with dual indicators (B-20) and (B-21) afford one kilovolt selection from 30 to maximum PKV for Radiography, Therapy and Fluoroscopy. The left hand control (B-4) increases in 10 PKV steps when turned to right, while the right hand control (B-5) increases 1 PKV per step when rotated. When operating at loads *under 10 MA*, these controls may be operated while the x-ray current is on.

MAIN LINE SWITCH - Incorporated in the Main Line Switch (B-24) is the overload circuit breaker which automatically shuts off the machine when the load goes beyond the safe limit. Always determine the cause of the overload before attempting to again close the main switch.

LINE COMPENSATOR - The line compensator (B-8) and indicator (B-16) is essentially a manually operated line voltage regulator. By means of the knob, proper autotransformer taps may be selected to match the line voltage. Proper adjustment is indicated when the indicator needle coincides with the single red line. When operating at loads *under 10 MA*, this control may be operated while the x-ray current is on.

SYNCHRONOUS TIMER AND PUSH BUTTON SWITCH - The synchronous motor-driven timer (B-19) controls exposure time between 1/20 second and 30 seconds in a various arrangement of steps and is of the repeating type. It is equipped with two scales, the upper scale providing control from 1/20 to 3 seconds in 1/20 and 1/4 second steps, and the lower scale providing control from 1/2 second to 30 seconds in 1/2 second steps. Scale changing is done by raising or lowering the indicating pointer mechanism (B-26) located on the upper edge of the timer dial.

When the push button switch (B-13) is depressed, the timer is set into operation, which in turn energizes the x-ray tube through the relay device. Releasing the push button switch for an instant resets the timing mechanism and another exposure duplicating the first may be begun at once.

FILAMENT REGULATOR - Vernier adjustment of x-ray tube current is controlled by means of the filament regulator (B-7). Right hand rotation increases x-ray tube current.

NOTE: Normally, this control should remain within a few degrees of a fixed position (See filament calibration instructions). Only in cases where extreme accuracy is required, or where the machine is operated almost continuously will it be necessary to use this control as a regulator. It is important to remember that changing this control on one MA setting means that the MA has been changed on *all other positions* and will be necessary to refer to the filament meter (B-1) and

MATTERN 200 MA UNIT

calibration to return the vernier control to its original position. Conversely, setting this control to the correct position on any one radiographic position means all remaining positions are corrected at the same time.

SPOT RADIOGRAPHIC FILAMENT REGULATOR - This control (B-12) provides for adjustment of fluoroscopic milliamperes when doing spot radiography, such that the settings for radiography are not affected. Turning this control to its minimum counter-clockwise position disconnects the footswitch and also cuts out this regulator to allow operation of the fluoroscopic tube at ordinary radiographic settings without the use of the spot device attachment.

BUCKY MAGNETIC RELEASE - The bucky magnetic release (B-17) push button controls the release of the bucky grid and timing mechanism. Pressure on the push button need only be momentary as it is necessary only to energize the solenoid release mechanism. The bucky grid may also be released manually by means of the cord attached to the release mechanism. Use of this switch is not required when using a rotating anode type radiographic tube.

STEREO SHIFT RELEASE - The stereo shift release (B-23) push button controls the stereo shift release solenoid. AGAIN, pressure on this push button need be **ONLY MOMENTARY**.

MILLIAMPERE SECOND SCALE PUSH BUTTON - The milliampere scale switch (B-28) is for use on units equipped with a ballistic milliampere second meter (H-2). Depressing this switch automatically disconnects the milliammeter from the circuit and connects the ballistic meter so as to read milliampere seconds.

FILAMENT METER - The filament meter (B-1) contains an *arbitrary* scale of reading from 50 to 200 in two division calibrations. It serves as an indication of the voltage being applied to the primary of the x-ray tube filament transformer.

MILLIAMPERE METER - The milliampere meter (B-2) is a double scale meter containing both 0-50 and 0-250 MA scale. Calibrations are in one milliampere on the 0-50 scale and in 5 milliamperes on the 0-250 scale.

PILOT LIGHT SWITCH - The pilot light switch (B-14) controls all lights in meters and indicators, except the line indicator which remains illuminated at all times.

MILLIAMPERE SECOND METER - This meter (B-2) is of the ballistic type and is for use on exposure of too short a duration to be read on the milliammeter. It is scaled for 0 to 50 MAS in calibrations of one MAS. It should be read at the point of its maximum swing which is an indication of the product of milliamperes and time, i.e., for a 1/10 second, 100 MA exposure the indicator will swing to 10 MAS, while at 1/10 second, 200 MAS the swing will be to 20 MAS, etc.

NOTE: Never use the ballistic meter for exposure times of longer than 1/4 second, as this is the maximum time range of the meter movement.

BUCKY TUBE AND DIAPHRAGM CENTERING DEVICES

FILM ON HORIZONTAL TABLE TOP - To obtain a predetermined Focal Film distance for this type of radiograph the indicator "T" should be used with the vertical scale on the tube stand. The scale then reads correct for distance from Target to Table Top.

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FILM IN BUCKY ON HORIZONTAL TABLE - The vertical scale on the tube stand reads correct for this type of radiograph when the indicator "B" is used. To correctly center the Tube Target over the Bucky locate the X-Ray Tube so that the indicator on the horizontal tube stand scale coincides with the Bucky indicator scale on the table.

FILM IN BUCKY ON VERTICAL TABLE - To correctly center the Bucky and Tube Target in this position the indicator "B" on the vertical tube stand scale should coincide with the "Bucky" indicator using the scale on the side of the table.

STEREO SHIFT OPERATION - Assembly of the scale on the cassette holder or changer should be made as shown in diagram #5285. Operation of Stereo Shift is explained in diagram #5276.

INSTRUMENT PANEL #11B-200 M.A. CONTROL

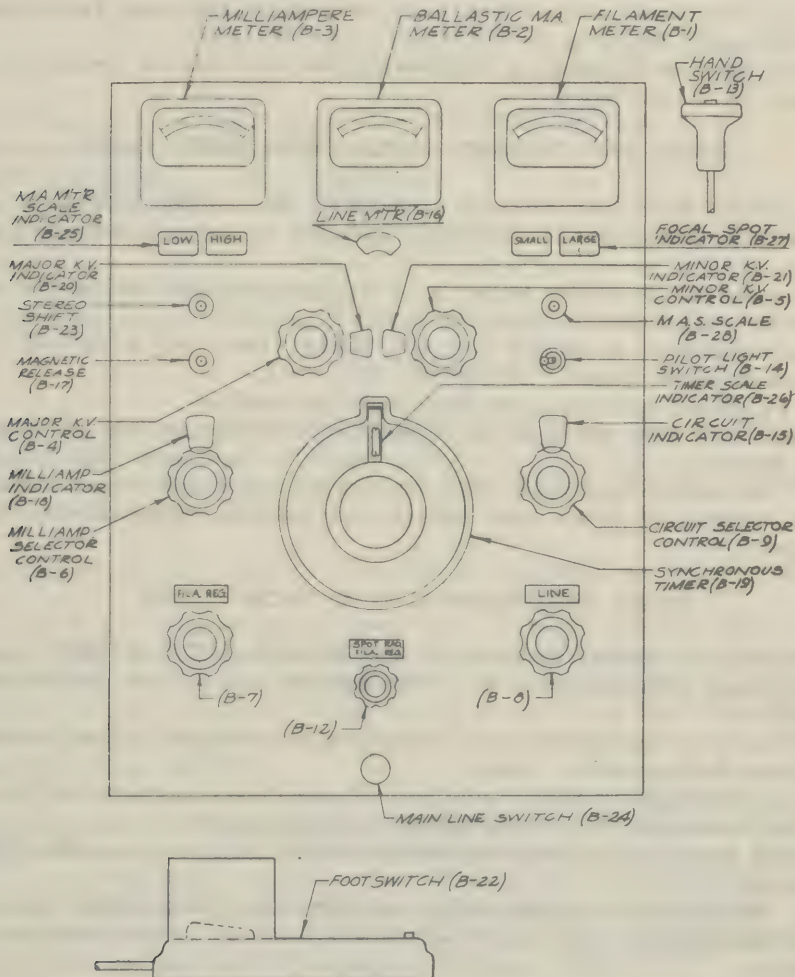


Diagram #5169-A

MATTERN 200 MA UNIT

WARNING!! ALWAYS BE CERTAIN THAT MILLIAMPERES, KILOVOLTS AND TIME FACTORS ARE SAFELY BELOW THE MAXIMUM LOAD RATING OF THE TUBE AND THAT THE X-RAY TUBE IS POSITIONED AT SUCH A DISTANCE OR PROPERLY FILTERED TO PROVIDE ADEQUATE SAFETY TO THE PATIENT WHEN THE FOLLOWING FACTORS ARE USED.

Important!! Follow instructions in the order in which they are given.

STEP BY STEP INSTRUCTIONS

RADIOGRAPHY

1. Set Circuit Selector Switch at "RAD. SYN. TIMER" position.
2. Set MA Selector Switch at MA position determined by technique.
3. Set kilovoltage determined by technique.
4. Close Main Line Switch.
5. Adjust line compensator control until line meter indicator is at red line.
6. Set Synchronous Timer for value determined by technique.
7. Position film and patient and make necessary tube and table angulations.
8. Check Filament Setting from Filament Calibration.
9. Exposure may now be made by depressing the Push Button Switch until time of exposure is completed.

BUCKY RADIOGRAPHY WITH SYNCHRONOUS TIMER

1. Set Circuit Selector Switch at "BUCKY RAD. SYN. TIMER".
2. Follow same procedures for RADIOGRAPHY up to and including Instruction 6.
3. Place cassette in bucky tray, position patient and align center of bucky grid with radiographic tube.
4. Pull out plunger on bucky and set bucky timer for slightly longer time than synchronous timer.
5. Check Filament Setting from Filament Calibration.
6. Exposure may now be made by MOMENTARILY depressing the MAGNETIC RELEASE switch.

NOTE: On units equipped with the rotating anode type tube, exposure is made by depressing timer hand switch and holding switch down until exposure is completed.

BUCKY RADIOGRAPHY WITH BUCKY TIMER

1. Set Circuit Selector Switch at "BUCKY RAD. BUCKY TIMER" position.
2. Follow same procedure as for RADIOGRAPHY up to and including Instruction 5.
3. Place cassette in bucky tray, position patient and align center of bucky grid with Radiographic tube.
4. Pull out plunger on Bucky and set Bucky Timer determined by technique.
5. Check Filament Setting from Filament Calibration.
6. Exposure may now be made by MOMENTARILY depressing the MAGNETIC RELEASE switch.

NOTE: On units equipped with the rotating anode type tube, exposure is made by depressing timer hand switch and holding switch down until exposure is completed.

THERAPY

1. Set Circuit Selector Switch at "THERAPY" position.

MATTERN 200 MA UNIT

2. Set MA Selector Switch at 5 MA position.
3. Set PKV Controls for 90 PKV (or lower if a lower KV Technique is used).
4. Close Main Line Switch.
5. Adjust line compensator control until Line Meter Indicator is at red line.
6. Set auxiliary therapy timer for time desired.
7. Position patient and tube.
8. Depress footswitch or auxiliary therapy timer switch to begin Therapy.
9. Now, slowly increase kilovoltage in 10 PKV steps, allowing about 30 seconds for each 10 PKV until approximate desired kilovoltage is reached and then in 1 PKV steps allowing approximately 5 seconds for each step until exact PKV is reached.

NOTE: If X-Ray MA is interrupted for any reason before Therapy is completed, the kilovoltage should be reduced to original starting value and above procedure repeated.

10. Auxiliary treatment timer will automatically cut off X-Ray tube current when pre-set time has elapsed.

FLUOROSCOPY

1. Set Circuit Selector Control at "FLUOROSCOPY" position.
2. Set MA Selector Control to 5 MA position.
3. Set PKV Control for value desired.
4. Close Main Line Switch.
5. Adjust Line Compensator Control so that Line Meter Indicator is at red line.
6. Check Filament Calibration.
7. Depress footswitch to begin Fluoroscopy.

SPOT RADIOGRAPHY

1. Mount spot radiographic device on screen frame and remove compensating counterweight from end of cross rods.

NOTE: Make certain that device is securely locked in position by means of spring lock on screen frame.

2. Insert spot device plug in receptacle provided on lower side of control panel.
3. Wind the spot mechanism so that the cassette holder is at left end of screen frame and in position for fluoroscopic work and insert cassette.
4. Set Circuit Selector Control in "SPOT RADIOGRAPHIC" position.
5. Set MA Selector Control to MA value needed for RADIOGRAPHY.
6. Set Spot Device Filament Regulator to its minimum counter-clockwise position.
7. Close Main Line Switch.
8. Adjust Line Compensator Control until Line Meter Indicator is at red line.
9. Check Filament Calibration for Radiographic setting required.
10. Depress Footswitch and rotate Spot Radiographic Filament Regulator until the desired fluoroscopic current (approximately 5 MA) is reached. *WARNING: BE CERTAIN THAT PROPER MA METER SCALE IS BEING READ.*
11. When a spot film is desired, depress the lever on side of Spot Film Device and hold lever down until exposure has been completed.
12. Return cassette tray to its "cocked" position and remove cassette. Unit is now ready for continued Fluoroscopy or another spot film.

MATTERN 200 MA UNIT

STEREO SHIFT OPERATION

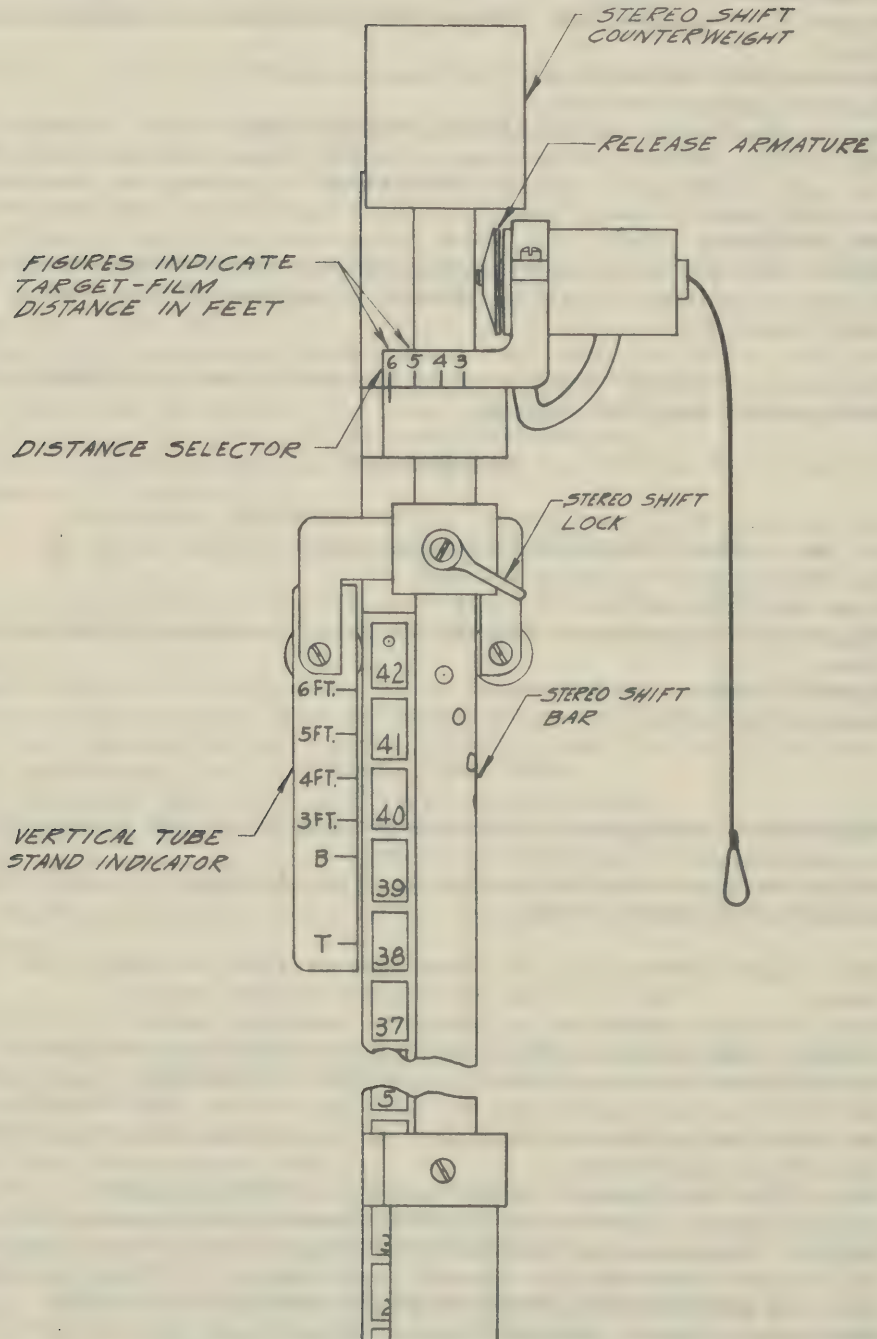


Diagram #5276

MATTERN 200 MA UNIT

STEREO SHIFT OPERATION

PROCEDURE:

1. Make certain Stereo Shift Bar is in lowered (released) position.
2. Determine position of Cassette Holder.
3. Determine Target to Film distance (3, 4, 5, or 6 feet).
4. With the Stereo Shift Lock released, locate vertical position of Tube so that Pointer opposite Target to Film Distance on Tube Stand Indicator coincides with Indicator on Cassette Holder.
5. Rotate Distance Selector to Target Film distance desired.
6. Lock Stereo Shift.
7. Lift Tube Assembly until Release Armature locks in place, making Tube ready for first Stereo Film.
8. After first Film is taken depress Stereo Shift Push Button on Control which automatically shifts Tube into position for second Film.

MATTERN 200 MA UNIT

MAINTENANCE

LUBRICATION - Lubrication of the moving parts is necessary about once each year. A medium weight lubricating oil (S.A.E. 20) is recommended at the following points:

All Roller Bearings: (One Drop of oil)
All Counterweight Wheel Bearings.
Synchronous Timer Motor. (Two points)

INSULATORS - All High-Voltage Terminals should be disconnected and cleaned about once each year. Use a clean cloth that is free from lint. Using alcohol carefully remove all dirt and vaseline. When parts are dry repack terminals with clean white vaseline and reassemble.

The Fluoroscopic Tube should be removed and its entire surface carefully cleaned. The inside panels of the table should be wiped free of dust.

FLUOROSCOPIC SCREEN - Wherever possible, do not expose the Fluoroscopic Screen to sunlight or high intensity artificial light. The screen should be kept covered with a dark protective cloth when not in use.

CLEANING AND POLISHING - Standard automobile finishes are used and may be cleaned and polished by methods similar to those used for automobiles.

PARTS REPLACEMENTS - When ordering replacement parts it is essential to include the serial number of the major assembly on which the part is included.

VALVE TUBE REPLACEMENT - An elevating mechanism is provided with the Transformer to raise the assembly out of the oil enough to make the valve tubes accessible. When making a valve tube replacement, the procedure is as follows:

1. Remove the terminal cover, the line cable and the trim ring, by removing the 22 ornamental nuts and washers.
2. Raise transformer assembly by clockwise rotation of crank to a height of about 14". (Red line on frame should not go above top of tank.)
3. Valve tube may be removed by pulling valve out toward the side of the tank to release clips.

CONNECTIONS FROM BRACKET TO TRANSFORMER NEED NOT BE DISTURBED.

X-RAY TUBE REPLACEMENTS - Since each X-Ray Tube has slight variations in Filament characteristics minor corrections for each milliamperes setting may be made by adjusting the variable resistors located in the lower front of the Control Unit. Means for correcting both milliamperes values and "space charge" characteristics are provided as indicated on the diagram mounted inside the lower front panel. When it is found necessary to make corrections the "Space Charge" correction should always be made first. A separate "Space Charge" adjustment is necessary for each MA setting and the lower values should be made first.

NOTE: This "Space Charge" correction is necessary only where it is found that varying PKV will cause considerable variation of milliamperes.

1. Set PKV at 50 and MA Selector at 5 MA.
2. Adjust Vernier Filament Regulator until exactly 5 MA is obtained.
3. Increase PKV and note any change in X-Ray current
4. If milliamperes tend to increase with PKV move the adjustable lead corresponding to the MA and Tube being used to one step lower in the Terminal Block.

MATTERN 200 MA UNIT

5. If increasing PKV tends to decrease milliamperes, the adjustable lead should be moved to one position higher on the Terminal Block.

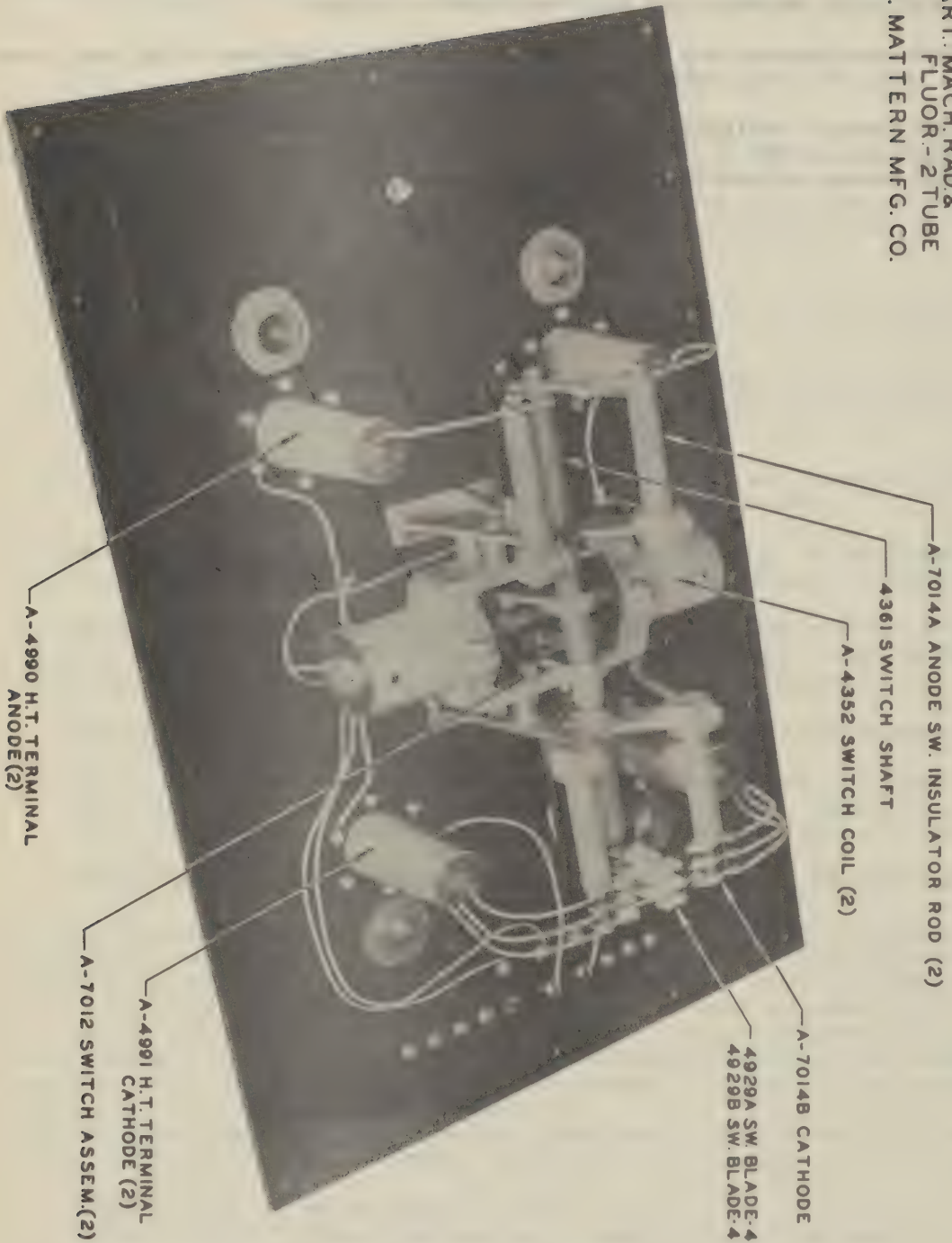
NOTE: It will be necessary to readjust the Vernier Filament Control to obtain exact MA after each adjustable lead is changed.

This same procedure may be used for each MA position and each X-Ray Tube; there being a total of 12 adjustable leads provided.

When making a milliampere correction, leave the Vernier Filament Control in a fixed position and PKV at 50, by means of resistors indicated in the diagram adjust the X-Ray current at each MA setting until the desired values are obtained.

MATTERN 200 MA UNIT

ITEM: 60915
ART: MACH. RAD. &
FLUOR.-2 TUBE
F. MATTERN MFG. CO.

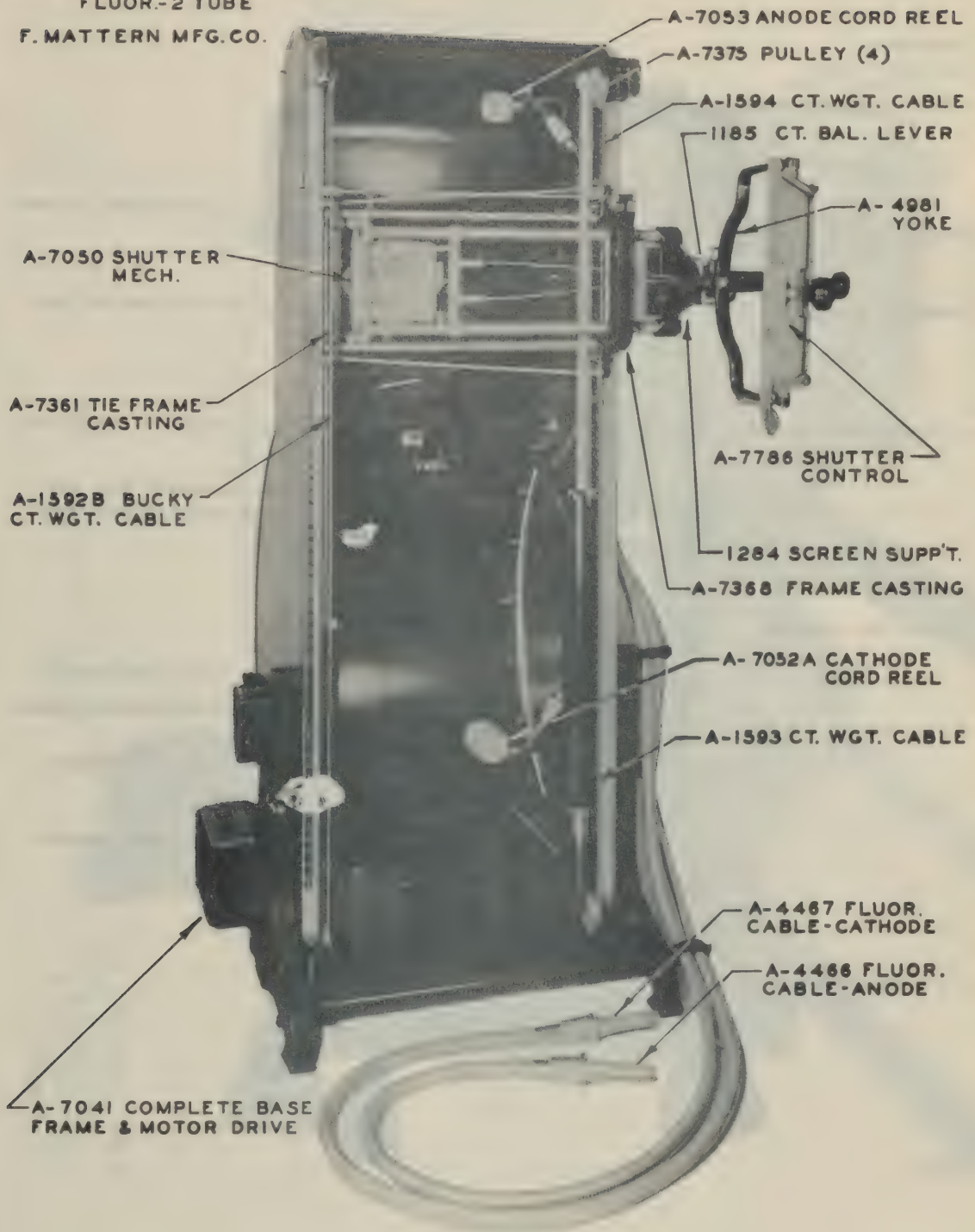


MATTERN 200 MA UNIT

ITEM 60915

ART. MACHINE RAD.&
FLUOR.-2 TUBE

F. MATTERN MFG. CO.

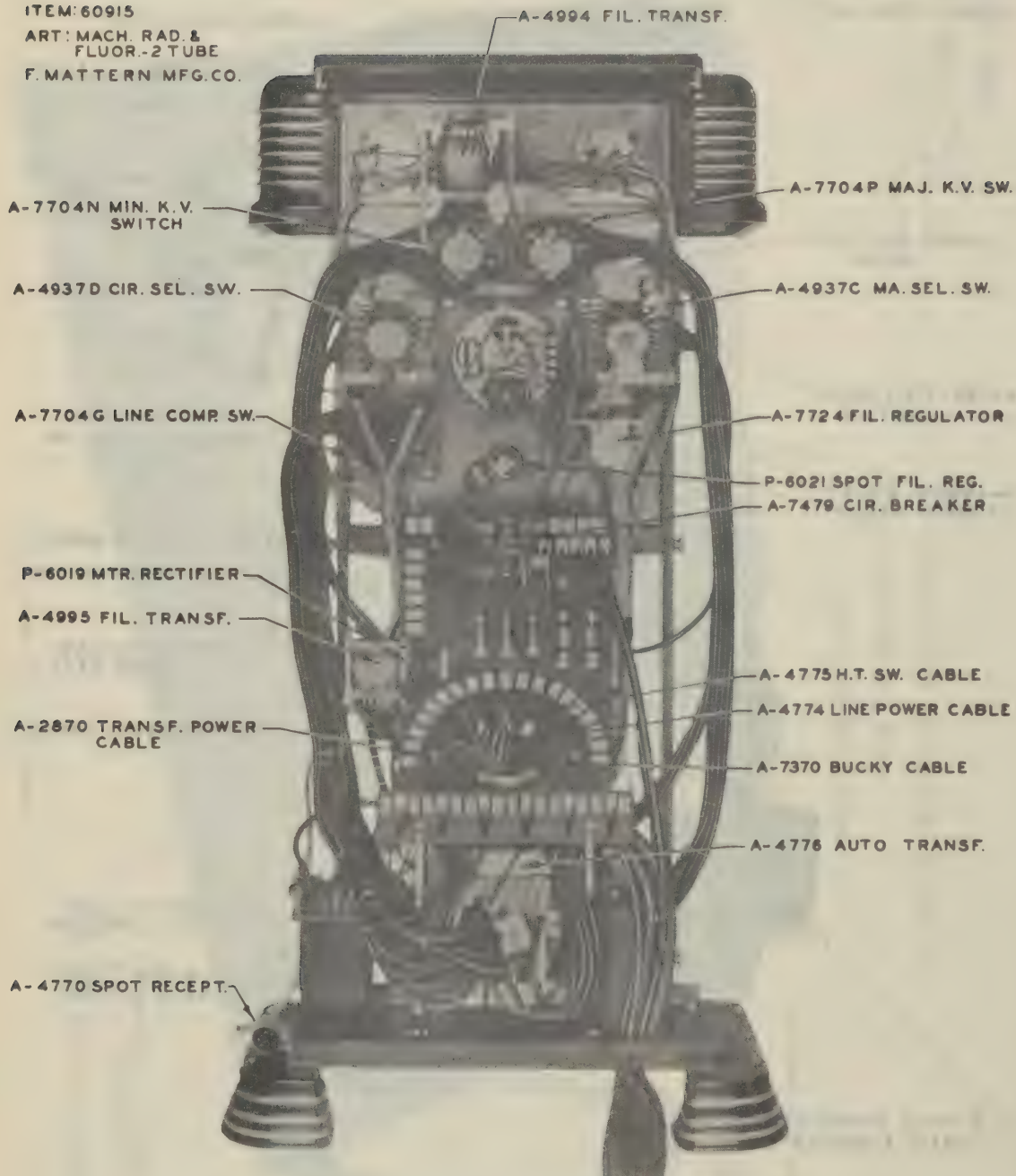


MATTERN 200 MA UNIT

ITEM: 60915

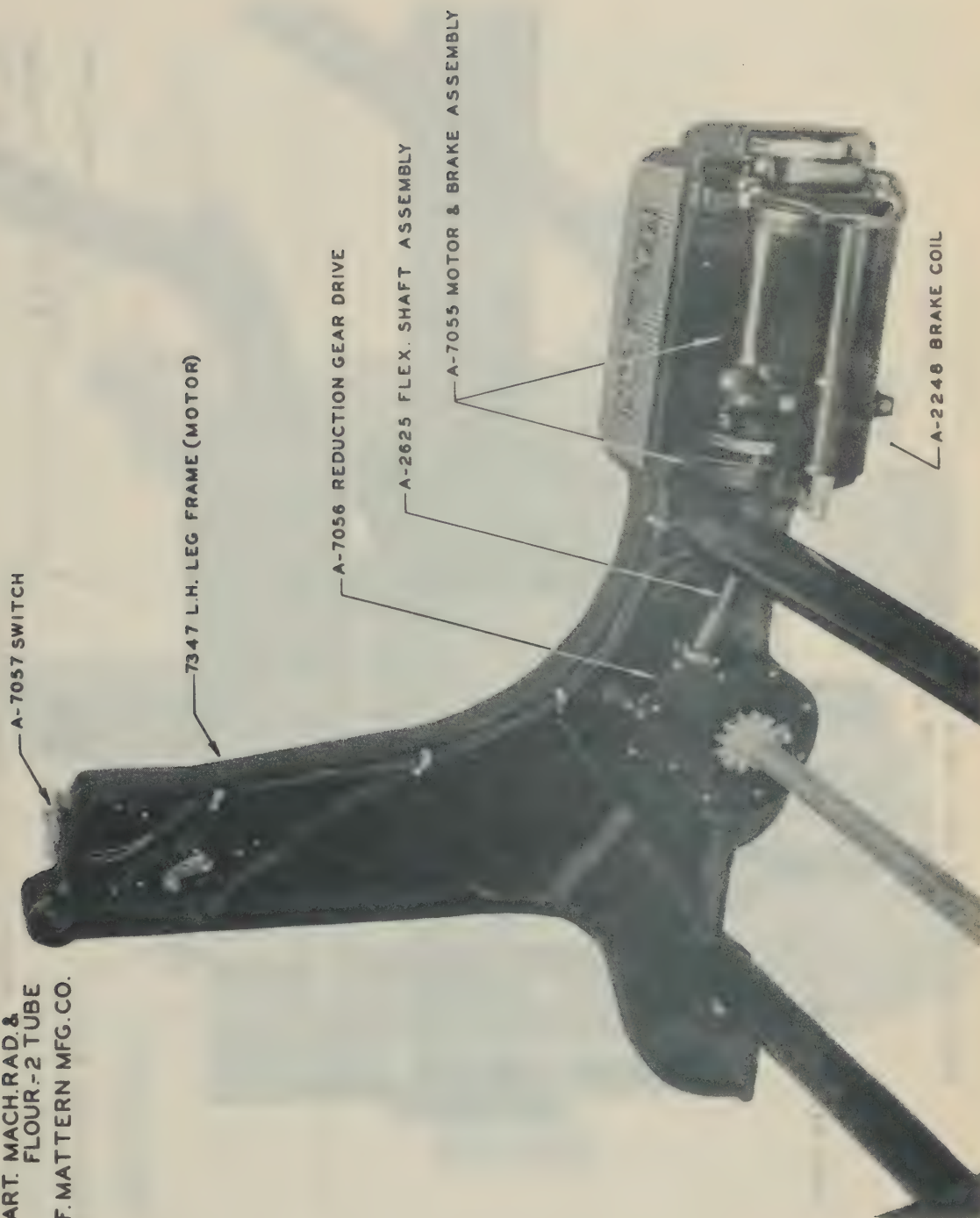
ART: MACH. RAD. &
FLUOR.-2 TUBE

F. MATTERN MFG. CO.

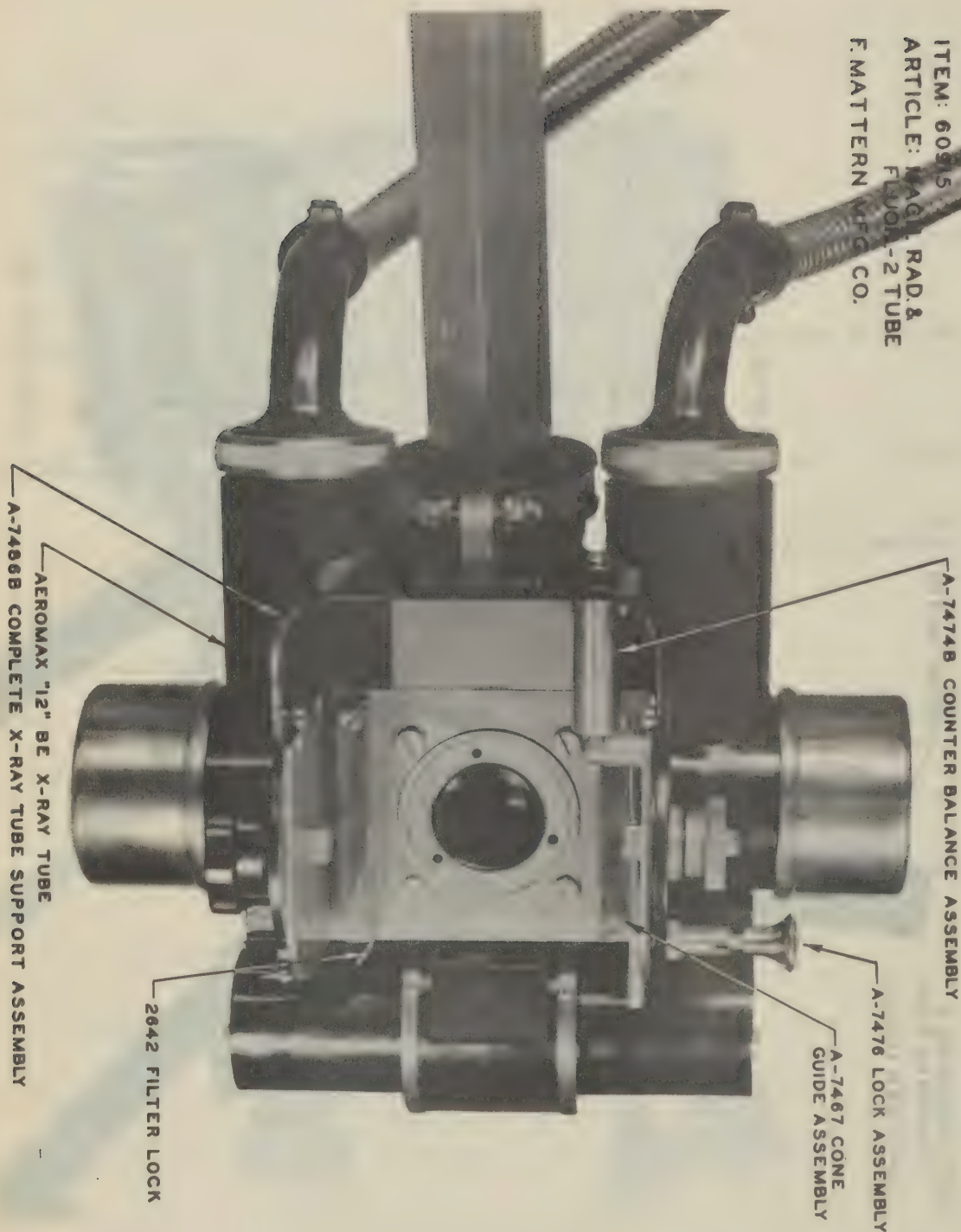


ITEM 60915

ART. MACH. RAD. &
FLOUR - 2 TUBE
F. MATTERN MFG. CO.



ITEM: 60915
 ARTICLE: MAGN. RAD. &
 FLUOR. - 2 TUBE
 F. MATTERN MFG. CO.



ITEM: 60915

ART: MACH. RAD &
FLOUR-2 TUBE
F. MATTERN MFG. CO.

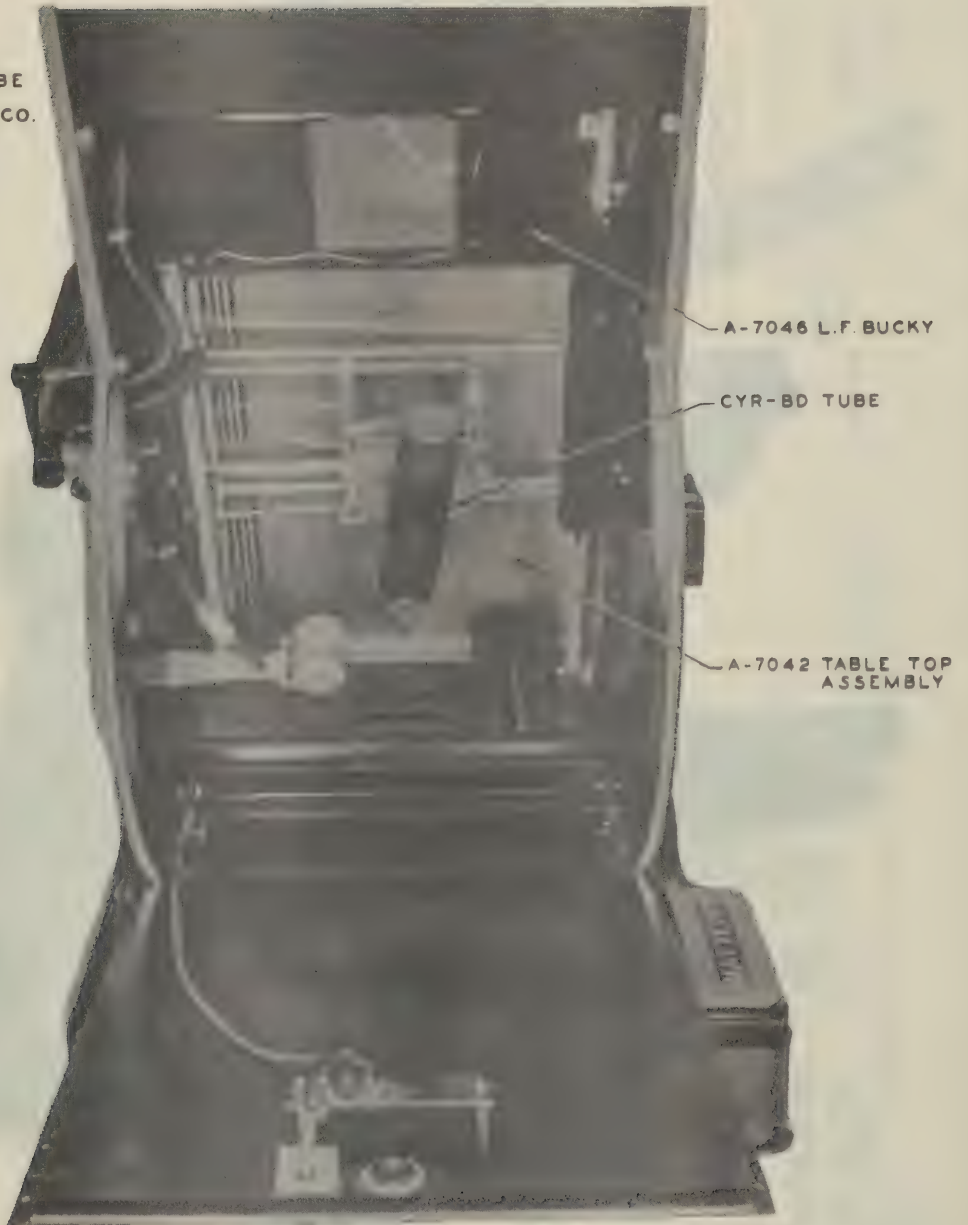


MATTERN 200 MA UNIT

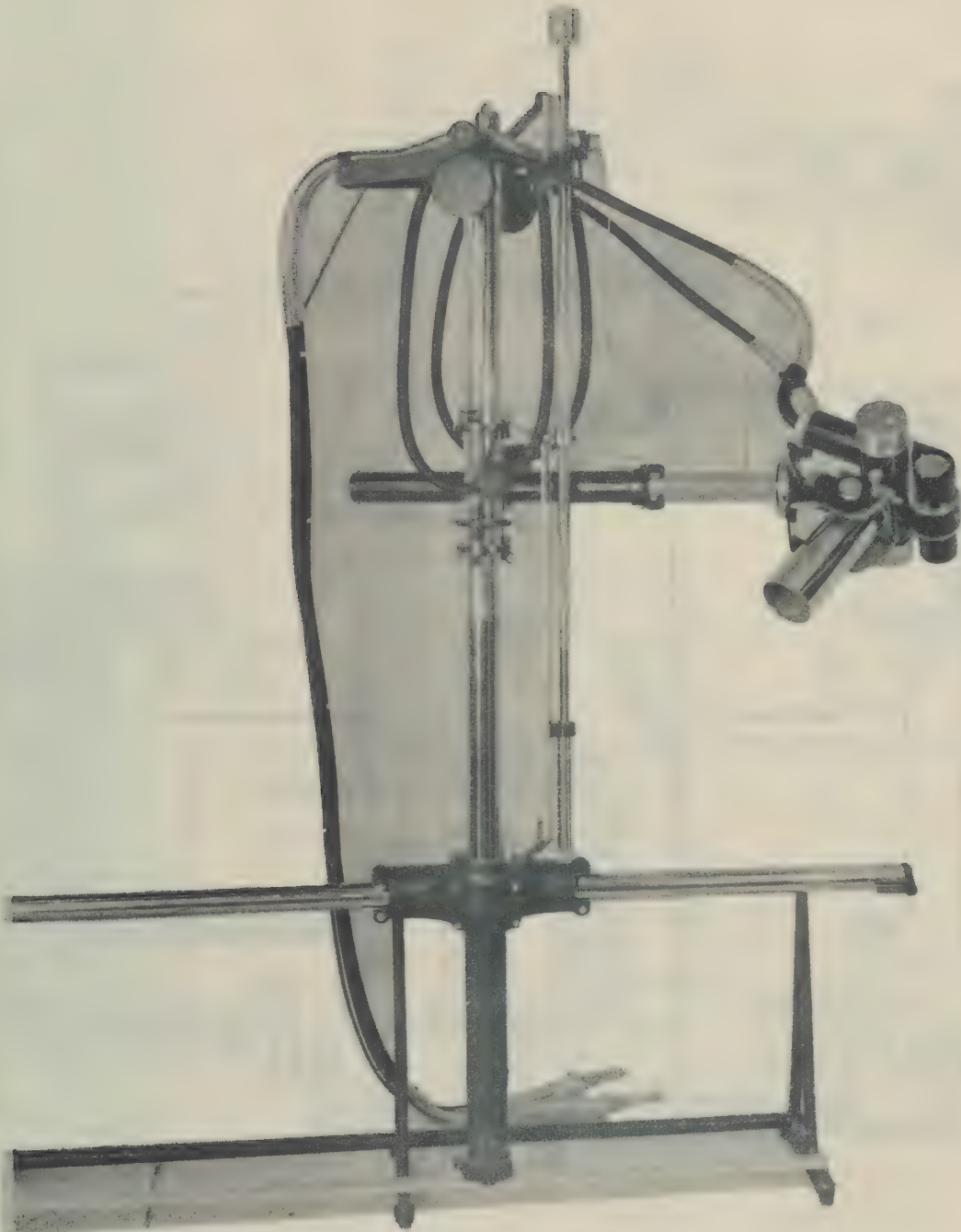
ITEM: 60915

ART: MACH. RAD. &
FLUOR.-2 TUBE

F.MATTERN MFG.CO.

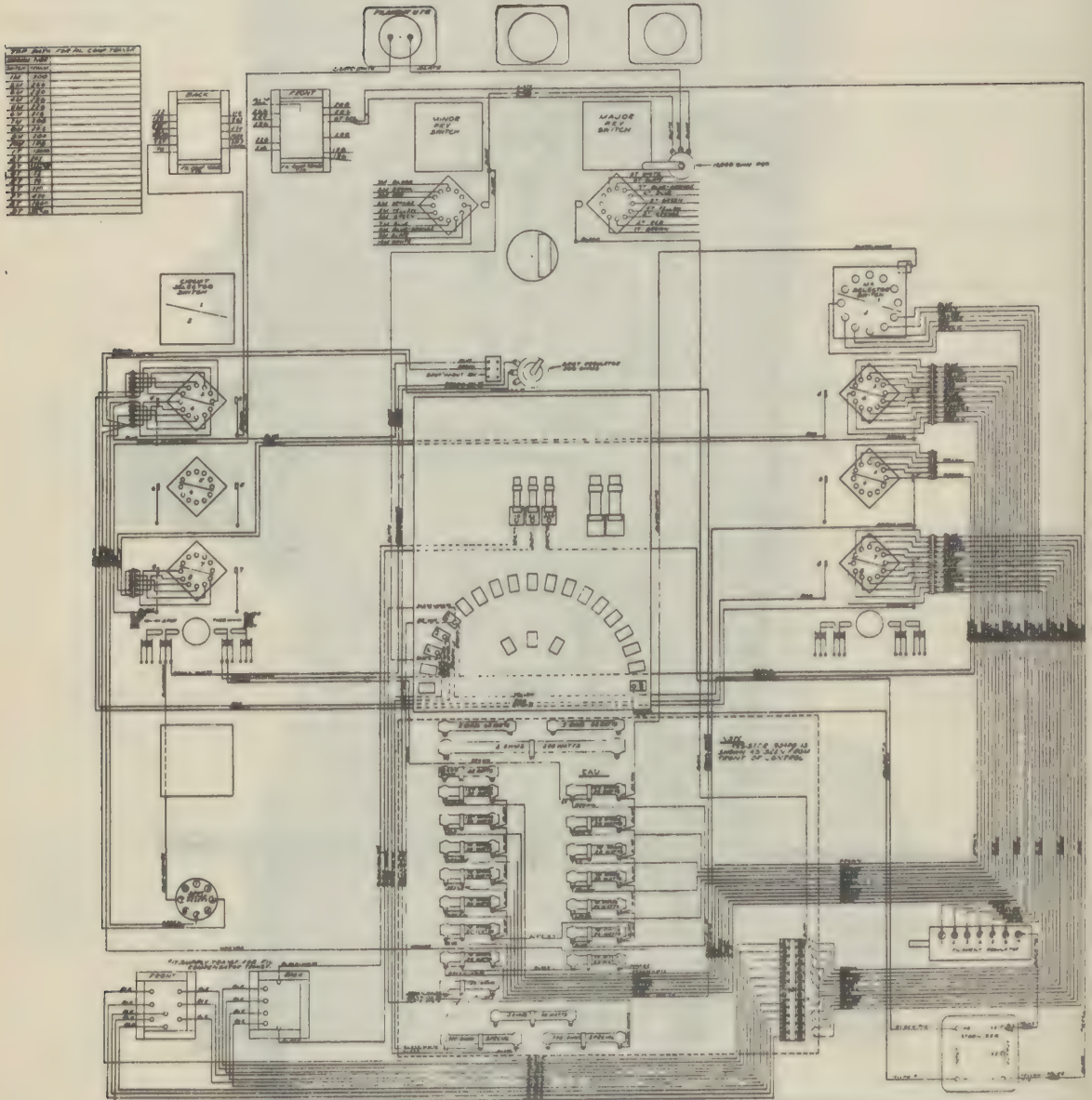


MATTERN 200 MA UNIT

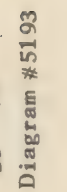


MATTERN 200 MA UNIT

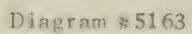
FILAMENT CIRCUIT - #11B CONTROL



SCHEMATIC CIRCUIT - #11B X-RAY CONTROL



#8 CIRCUIT WIRING DIAGRAM - #11B CONTROL



MATTERN 200 MA UNIT

H.T. SWITCH CIRCUIT - #11B CONTROL

NOTE:

ALL WIRE # 6 R.C.L. UNLESS
OTHERWISE SPECIFIED

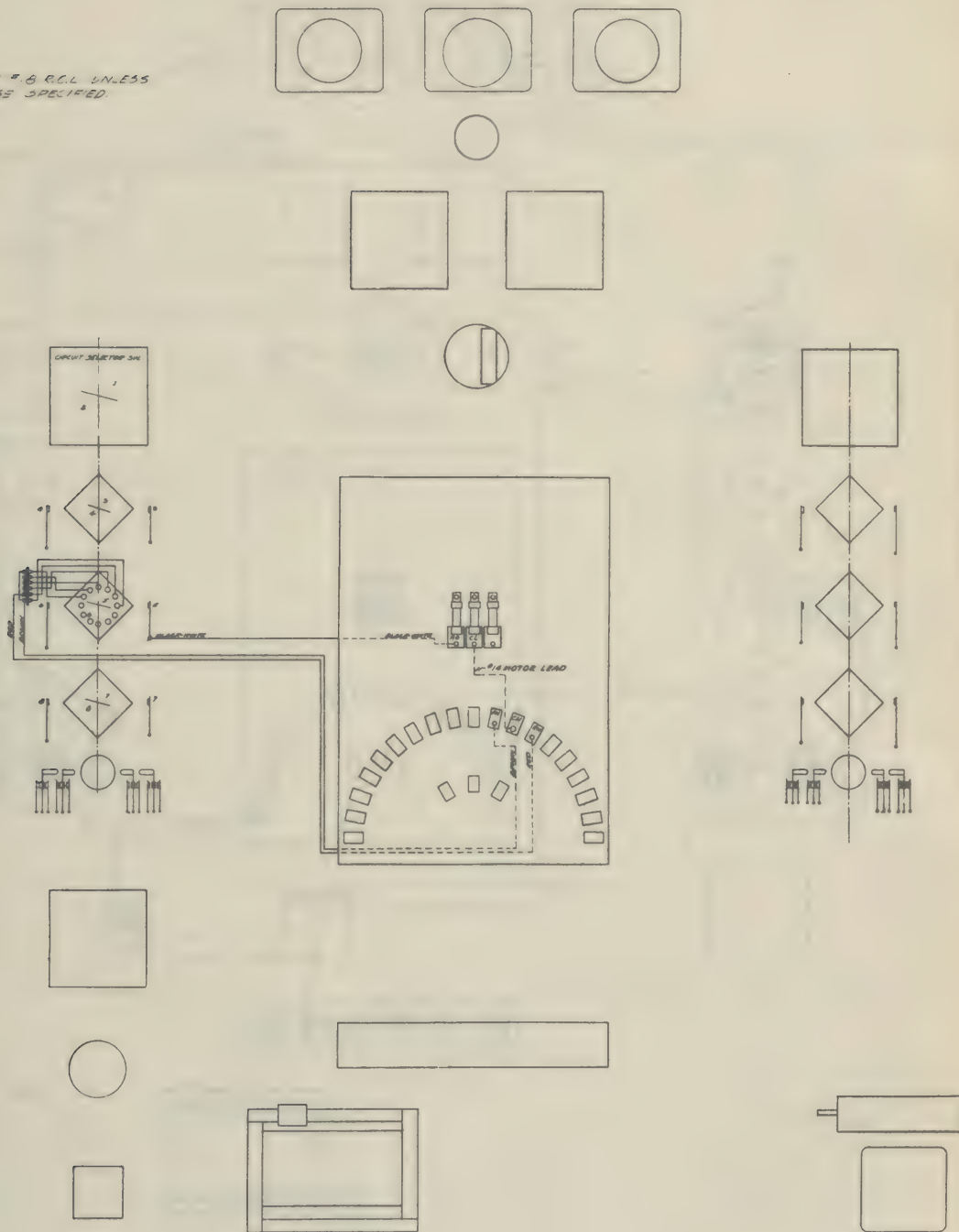


Diagram #5160

MATTERN 200 MA UNIT
VALVE FILAMENT CIRCUIT - #11B CONTROL

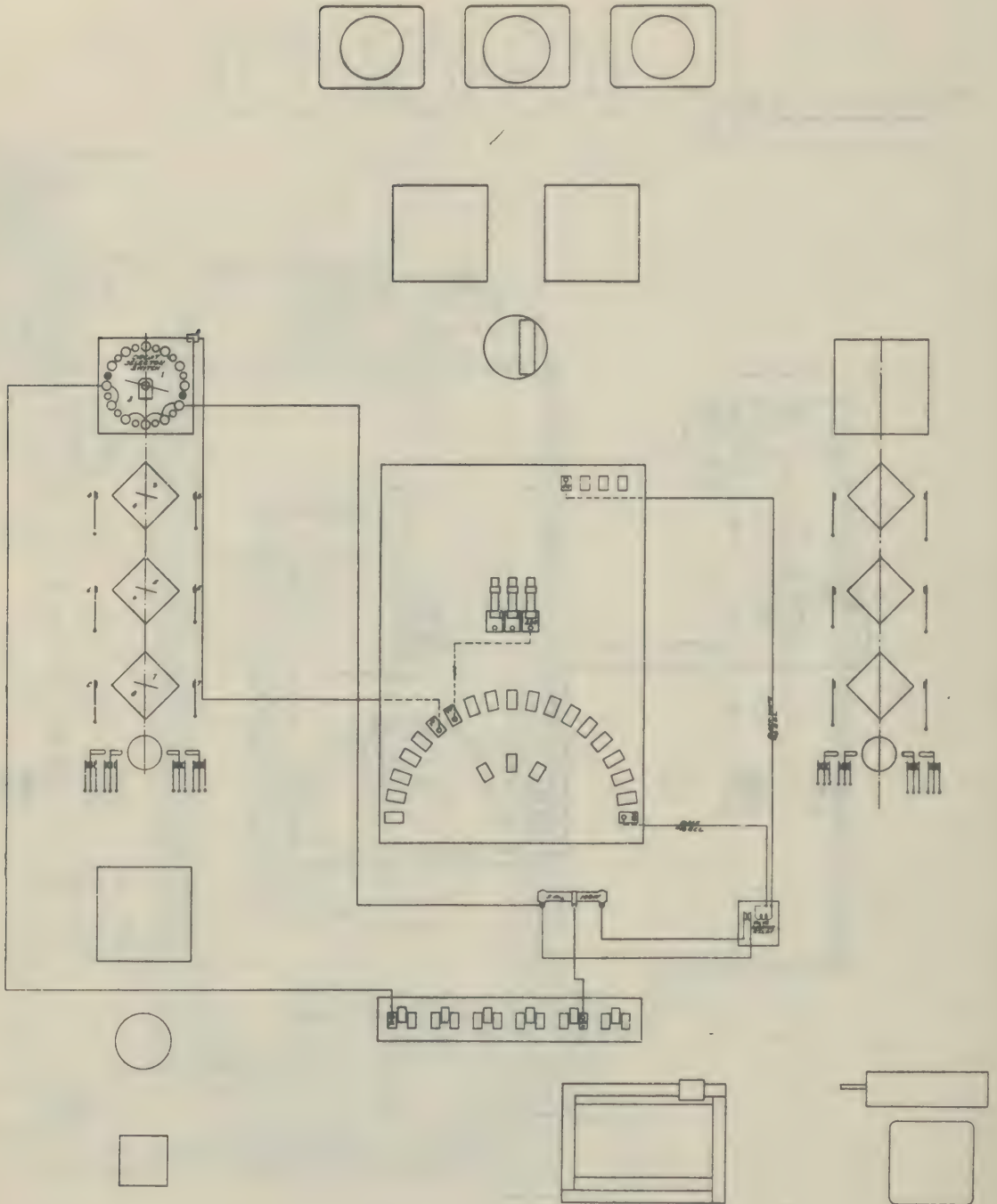


Diagram #5159

MATTERN 200 MA UNIT

PILOT LIGHT CIRCUIT - #11B CONTROL

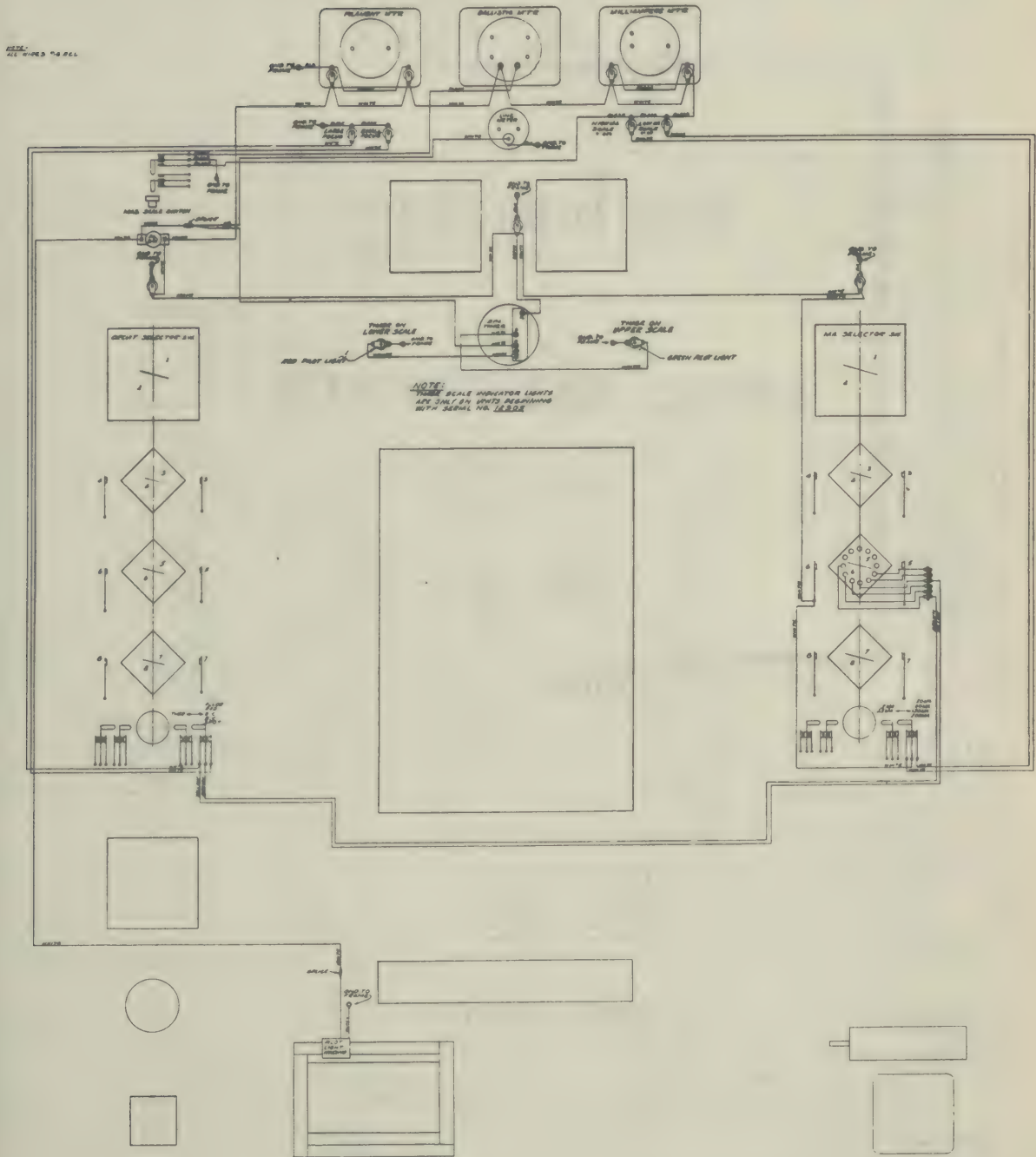


Diagram #5157

MATTERN 200 MA UNIT
MA METER CIRCUIT - #11B CONTROL

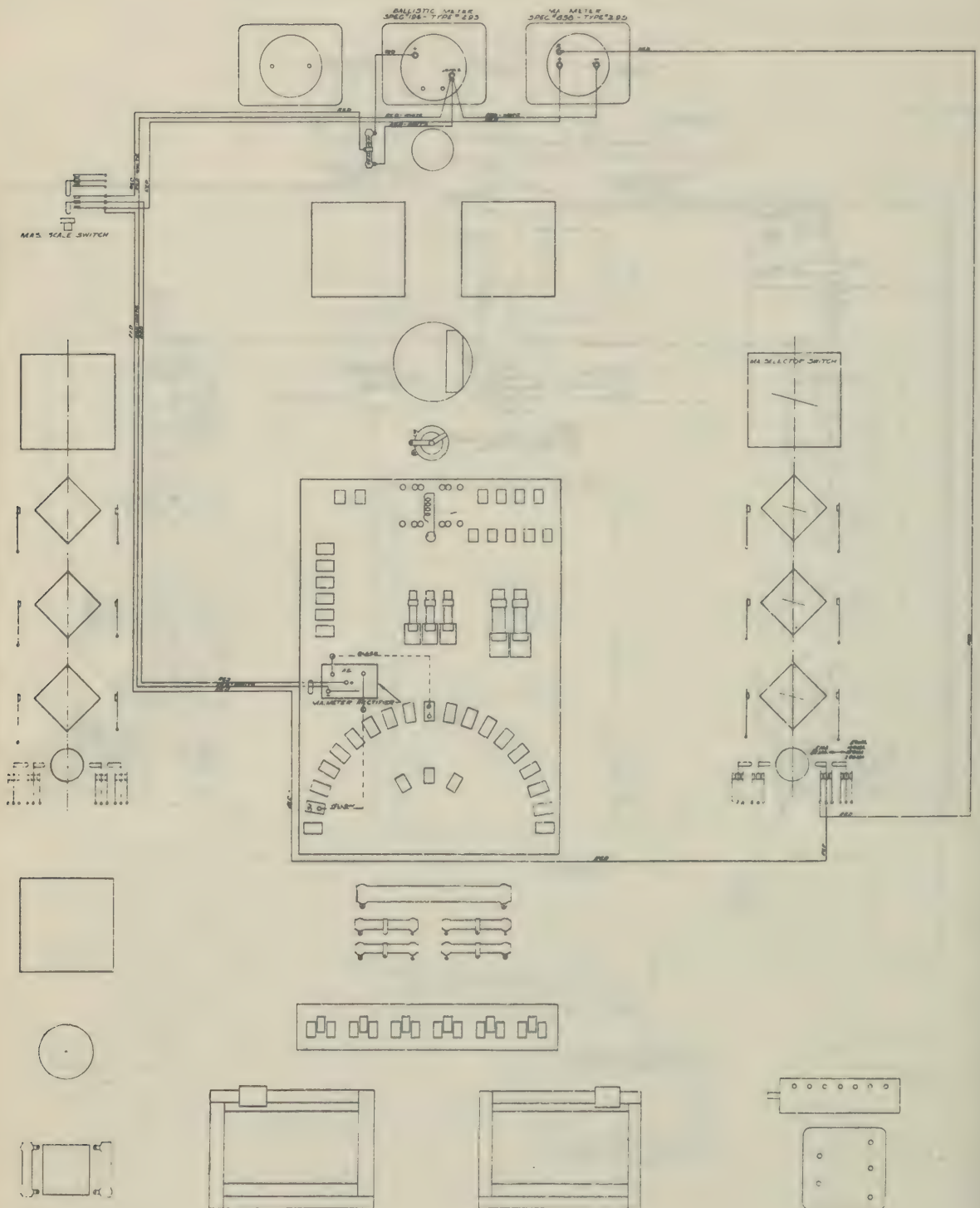


Diagram #5156

SECTION LVII

FLUORESCENT LAMPS

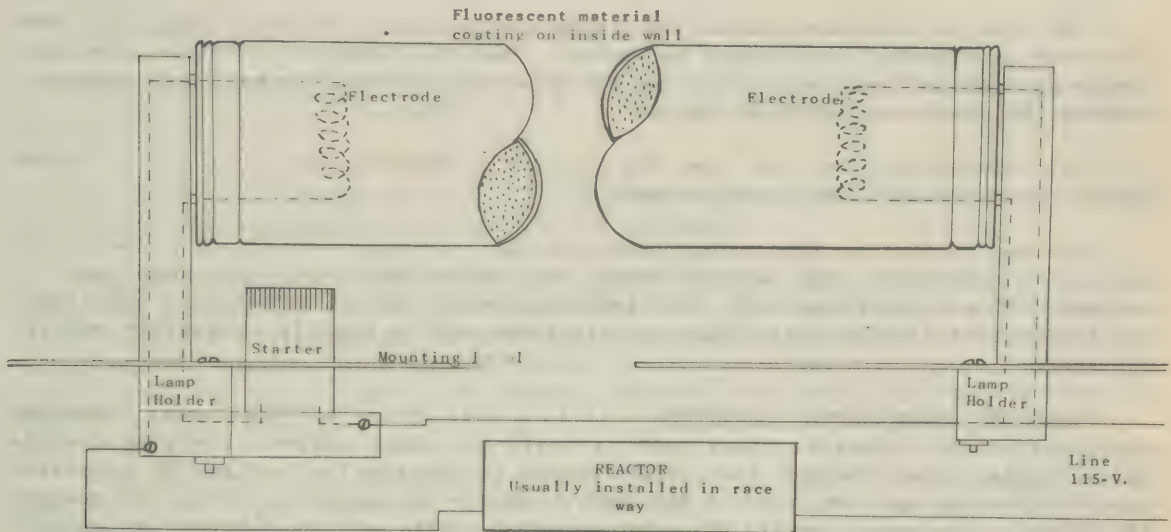
SECTION LVII

FLUORESCENT LAMPS

FLUORESCENT LAMPS

In contrast to the filament type lamp, in which electricity flows from one lead wire to another through the solid tungsten wire thus heating it to incandescence, the fluorescent lamp in common with other electric discharge devices makes use of ultra-violet energy to activate a fluorescent material coated on the inside of the bulb's surface.

The illustration below is of a typical fluorescent lamp assembly showing all its component parts.



The lamp in its present form consists of a tubular glass-bulb with two external contacts at each end, which are connected to filament-type electrodes made of coiled tungsten wire. These filament electrodes are coated with an active electron emissive material. Within the bulb there is a small drop of mercury and also a low pressure (a few millimeters) of pure argon gas to facilitate starting. The coating material used on the inside wall depends upon the color effect desired and may consist of Zinc Silicate, Cadmium Silicate or Calcium Tungstate. These organic chemicals are known as Phosphors, which powder transforms short-wave invisible radiation into visible light.

STARTING AUXILIARIES - Fluorescent lamps in common with all electric discharge apparatus requires auxiliary control equipment. The function of the starting auxiliaries is to create a momentarily high-voltage impulse in order to establish an arc between the electrodes at the opposite ends of the tubular lamp.

The auxiliary consists of two principal elements: 1, an iron core reactor choke coil (ballast) which limits the arc current, and 2, a starting switch which momentarily closes and then opens the electrode heating circuit.

Each lamp requires a separate auxiliary, although the elements for two or more lamps may be contained in a single unit. Specifically designed ballast equipments are required for each wattage size, frequency and voltage range.

When the lamp was first introduced, a number of starting methods such as the

FLUORESCENT LAMPS

thermal switch, resonant and magnetic switch type were utilized. Recently a switch known as the glow switch, operating on the thermal principle, has been introduced.

OPERATION OF GLOW SWITCH - This glow switch is a device about 1 inch long and about 3/8 inch in diameter and resembles a miniature electric lamp, but contains an easily ionized gas and two bi-metallic electrodes which serve as the switch contacts. The switch is connected in series with the fluorescent lamp electrodes; when the current is turned on, a glow discharge is created between the normally open switch contacts on the bi-metallic electrodes.

The heat of the flow causes the contacts to close. At this point the lamp electrodes are heated to a bright red color. When the contacts close the glow discharge automatically ceases, allowing the bi-metal elements to cool and separate, opening the switch and striking the arc.

This operation, from the time the current is applied until the arc is established, requires only one or two seconds.

As used in the new fluorescent lamp starter, the glow switch and a small condenser, to eliminate radio interference, are housed in a small aluminum shell equipped with a bayonet-type end, inserted in a special socket attached to the standard fluorescent lamp holder. Thus the starting unit is readily accessible and replaceable.

NEED FOR POWER FACTOR CORRECTION - It is a well known fact that power consuming apparatus of the inductive class such as coils and other current limiting devices has a lagging power factor, i.e., the current is lagging the voltage by a certain amount depending upon the size of the coil or device in question. Thus, for example, the equation for power in all direct current circuits and in alternating current circuits containing only pure ohmic resistance is,

$$\text{watts} = \text{volts} \times \text{amperes}$$

If, however, other circuit elements be present, as in the case of the fluorescent lamp circuit, with the inductive choke coil in series with it, the equation for true power becomes,

$$\text{watts} = \text{volts} \times \text{amperes} \times \text{power factor}$$

The power factor of the average fluorescent lamp itself is approximately 90%, practically, however due to the ballast choke the power factor for the complete unit is reduced from 50% to 60%.

As an illustration of the effect of power factor, suppose that a load of 250 watts is connected to a 125-volt circuit. The current in this circuit will be 2 amperes if the power factor is 100%, but if it is only 60%, for example, 3-1/3 amperes will be required to supply the same power. In other words, an extra 1-1/3 amperes must be circulated through the transmission system producing heating of the wires with a consequent loss of power.

It is evident from the above, that especially where a large number of lamps be required, certain corrective equipment is required to increase the power factor and thus increase the economy of operation. An effective method of improving the power factor to unity (or nearly so) is to connect a suitable condenser across the choke coil in the case of single lamp ballast and in case of two lamps ballast to use the "split phase" principle with one of the lamps ballasted by inductive reactance only

FLUORESCENT LAMPS

and the other by inductance and capacitance in series.

RADIO INTERFERENCE - The fluorescent lamp in common with most electrical devices may cause a certain amount of radio interference. This interference may be caused by one of the following factors:

High frequencies from this device to the radio. This effect diminishes rapidly as the radio is separated from the lamp. Thus, for example, at a radius of 9 ft. interference from this cause is negligible.

Line radiation from the electric supply line to the antenna.

Line feed-back from the lamp through the line to the radio. Interference from line radiation and line feed-back can be minimized by proper application of line filters.

The latter two causes of radio interference effects may be reduced to a minimum by incorporation of proper condensers in the equipment.

CIRCUIT VOLTAGES - With fluorescent lamps, voltage regulation depends upon the choke used and not on the starting mechanism. The power source, unless otherwise stated should be alternating current at a frequency of 60 cycles per second, although special auxiliaries are manufactured for use on other commercial frequencies as well as on direct current. The voltage range of the lamps including ballast is from 110 to 250 volts.

Some lamps will operate on D.C. as well as on A.C. depending entirely upon the type of starter units employed. Others will require the insertion of a 180-200 ohm resistor in series with one side of the starter unit. Numerous types and makes of fluorescent lights, and starting units have been employed since this type of lighting originated. It is impossible to determine any set rule for the operation of fluorescent lighting on D.C. voltage. With the proper type of resistance, fluorescent lights can be made to operate satisfactorily on D.C. voltage.

Frequent starting of lamps may take more life out of the electrodes than long hours of burning because momentarily there is a higher than normal voltage drop at the electrodes which causes the active material to sputter or evaporate. If a lamp be started once a minute, for example, the hours of burning will be shorter than normal, but if it be turned on and burned continuously, its life will be longer than normal. When the active material on the electrodes is nearly exhausted, the voltage required for starting will rise and may equal or exceed the available supply. This may occur after the lamp has been started thousands of times or burned beyond its rated life. Sometimes the end of life is indicated by the lamp flashing momentarily and then going out.

Fluorescent lamps will burn in any position, although when burned in a vertical position the condensing mercury may cause a slight streaking of the powders upon condensation. Like filament lamps the larger sizes as represented by length are more efficient than shorter length lamps. Efficiency is also dependent upon fine relationship of current density and vapor pressure. These are in turn affected by operating temperature.

SECTION LVIII

TABLES

SECTION XVIII

TABULAR

TABLES

UNITS OF MEASUREMENT

THE FUNDAMENTAL UNITS - It is of importance to have a standardized system of units whereby the calculation of quantitative work can be performed with ease, and convenience, and, at the same time, a clear comprehension can be afforded all nations in their scientific endeavor. The standards of measurements were agreed upon by seventeen nations participating in the 1875 International Metric Convention. Of those standards the metric system was adopted for use in scientific work in all countries, because of its affording a convenient method for expressing the relations between its units in multiples of ten.

The fundamental quantities chosen for the international scientific system are length, mass, and time; and, in metric system, the practical units assumed are, respectively, the centimeter, the gram, and the second, and hence the system is universally known as the C.G.S. System - named after the initial letters of these units. All electrical and magnetic units are based on C.G.S. System, the use of which is constantly increasing throughout the nations.

HANDY TABLES - In the following tables the values of different units are given so that you may be able to express the value of one unit in an equivalent term of another unit. As 1 foot = 12 inches = 0.333 yards, etc. In order to change the values from one set of units to another, all that is required is to multiply by the equivalent or equal value given in these tables. For example: It is desired to change 4 meters to feet, or to find how many feet there are in 4 meters. From the table, 1 meter = 3.28 feet. Then 4 meters = $4 \times 3.28 = 13.12$ feet.

LENGTH

1 Mil = .0254 millimeters = .001 inches
1 Millimeter = 39.37 mils = .03937 inches
1 Centimeter = .3937 inches = .0328 feet
1 Inch = 25.4 millimeters = .083 feet = .0278 yards = 2.54 centimeters
1 Foot = 304.8 millimeters = 12 inches = .333 yards = .305 meters
1 Yard = 91.44 centimeters = 36 inches = 3 feet = .914 meters
1 Meter = 39.37 inches = 3.28 feet = 1.094 yards
1 Kilometer = 3281 feet = 1094 yards = .6213 miles
1 Mile = 5280 feet = 1760 yards = 1690 meters = 1.609 kilometers

AREA

1 Circular mil = .7854 square mils = .0005067 square millimeters
= .0000007854 square inches
1 Square mil = 1.273 circular mils = .000645 square millimeters
= .000001 square inches
1 Square millimeter = 1973 circular mils = 1550 square mils
= .00155 square inches
1 Square centimeter = 197300 circular mils = .155 square inches
= .00108 square feet
1 Square inch = 1273240 circular mils = 6.451 square centimeters
= .0069 square feet
1 Square foot = 929.03 square centimeters = 144 square inches
= 0.1111 square yards = .0929 square meters
1 Square yard = 1296 square inches = 9 square feet = .000207 acres
1 Square meter = 1550 square inches = 10.7 square feet
= 1.195 square yards = .000247 acres
1 Acre = 53560 square feet = 4840 square yards = 4047 square meters
= .004047 square kilometers = .001562 square miles
1 Square kilometer = 10,760,000 square feet = 1,196,000 square yards
= 247 acres = .3861 square miles

TABLES

1 Square mile = 27,880,000 square feet = 3,098,000 square yards
 = 2,590,000 square meters = 640 acres = 2.59 square kilometers

VOLUME

1 Circular mil = foot = .000,009,424 cubic inches
 1 Cubic Centimeter = .061 cubic inches = .0021 pint (liquid)
 = .0018 pint (dry)
 1 Cubic inch = 16.39 cubic centimeters = .0346 pint (liquid)
 = .0298 pint (dry) = .0043 gallons = .0005787 cubic feet
 1 Pint (liquid) = 473.17 cubic centimeters = 28.87 cubic inches
 1 Pint (dry) = 550.6 cubic centimeters = 33.60 cubic inches
 1 Quart (liquid) = 946.36 cubic centimeters = 57.75 cubic inches
 = 2 pints (liquid) = .25 gallons
 1 Liter = 1000 cubic centimeters = 61.023 cubic inches
 = 2.1133 pints (liquid) = 1.8162 pints (dry) = .098 quarts (dry)
 = .2642 gallon (liquid) = 0.03531 cubic feet
 1 Quart (dry) = 1101 cubic centimeters = 67.20 cubic inches
 = .03889 cubic feet
 1 Gallon = 3785 cubic centimeters = 231 cubic inches = 8 pints
 = 4 quarts = .1337 cubic feet = .004951 cubic yards
 1 Cubic foot = 28317 cubic centimeters = 1728 cubic inches
 = 28.32 liters = 7.48 gallons = .02832 cubic meters
 1 Cubic yard = 46656 cubic inches = 27 cubic feet = .7646 cubic meters
 1 Cubic meter = 61023 cubic inches = 1000 liters = 35.31 cubic feet
 = 1.308 cubic yards

WEIGHT

1 Milligram = .01543 grains = .001 grams
 1 Grain = 64.80 milligrams = .002286 *(avoirdupois)
 1 Gram = 15.43 grains = .03527 ounces = .002205 pound*
 1 Ounce = 437.5 grains = 28.35 grams = .0625 pound = 16 drams
 1 Pound = 7000 grains = 453.6 grams = 256 drams = 16 ounces
 = 0.4536 kilograms
 1 Ton = 2000 pounds = 907.2 kilograms = 0.9072 metric tons
 = .8928 long tons
 1 Metric ton = 2205 pounds = 1000 kilograms = 1.102 tons
 = .9842 long tons
 1 Long ton = 2240 pounds = 1.12 short tons = 1.016 metric tons

ENERGY AND TORQUE

1 Watt-second = 1 joule = .7376 foot-pound
 = .0009480 British thermal units = .0002778 watt hours
 1 Foot-pound = 1.346 watt-seconds = .001285 British thermal units
 = .0003766 watt-hours = .000000505 horsepower-hours
 1 British thermal unit = 1055 watt-seconds = 788.1 foot-pounds
 = .293 watt-hours = .000393 horsepower-hours
 1 Watt-hour = 3600 watt-seconds = 2655.4 foot-pounds
 = 3.413 British thermal units = .001341 horsepower-hours
 1 Horsepower-hour = 2,685,600 watt-seconds = 1,980,000 foot-pounds
 = 273,700 kilogram-centimeters = 746 watt-hours

*The pound and ounces are avoirdupois weight

TABLES

POWER

1 Foot-pound per minute = .02260 watts = .0000303 horsepower
1 Watt = 44.26 foot-pounds per minute = .001 kilowatts
1 Horsepower = 33,000 foot-pounds per minutes = 746 watts
= 550 foot-pounds per second
1 Kilowatt = 44256.7 foot-pounds per minute = 1.341 horsepower

CIRCLES

Circumference of a circle = diameter x 3.1416
Circumference of a circle = radius x 6.2832
Area of a circle = diameter squared x .7854
Area of a circle = circumference squared x .07958
Area of a circle = half the circumference x half its diameter
Radius of a circle = circumference x .159
Diameter of a circle = circumference x .3183
Diameter of a circle = square root of the area x 1.128

SPHERE

Volume of a sphere = surface of a sphere x 1/6 its diameter
Volume of a sphere = the cube of the diameter x .5236
Volume of a sphere = the cube of the radius x 4.188
Volume of a sphere = the cube of the circumference of the
sphere x .0168
Area of the surface of a sphere = the circumference x its
diameter
Area of the surface of a sphere = diameter squared x 3.1416

TEMPERATURE

Temperature Centigrade (C) = $\frac{5}{9} \times (\text{Temp. F.} - 32)$
Temperature Centigrade (F) = $\frac{9}{5} \times (\text{Temp. C.} - 32)$

Factors commonly used in the X-Ray Field.

Heat units (x-ray tubes) = K.V. x M.A. x T. (KVxMAS)

TABLES

PERIODIC SYSTEM OF THE ELEMENTS

Ia	IIa	IIb	IVb	Vb	VIb	VIIb	VIII	IX	X	IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
																	2
1 H																	He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57—71 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 —	88 Ra	89 Ac	90 Th	91 Pa	92 U	—	—	—	—	—	—	—	—	—	—	—	—

ELEMENTS AND ATOMIC WEIGHTS

Atomic No.	Symbol	Name of Element	Pract. Atom. Weight	Atomic No.	Symbol	Name of Element	Pract. Atom. Weight
1	H	Hydrogen	1.0078	47	Ag	Silver	107.88
2	He	Helium	4.002	48	Cd	Cadmium	112.41
3	Li	Lithium	6.940	49	In	Indium	114.8
4	Be	Beryllium	9.02	50	Sn	Tin	118.70
5	B	Boron	10.82	51	Sb	Antimony	121.76
6	C	Carbon	12.00	52	Te	Tellurium	127.5
7	N	Nitrogen	14.008	53	I	Iodine	126.92
8	O	Oxygen	16.000	54	X	Xenon	130.2
9	F	Fluorine	19.00	55	Cs	Caesium	132.81
10	Ne	Neon	20.18	56	Ba	Barium	137.36
11	Na	Sodium	20.997	57	La	Lanthanum	138.90
12	Mg	Magnesium	24.32	58	Ce	Cerium	140.13
13	Al	Aluminium	26.97	59	Pr	Praseodymium	140.92
14	Si	Silicon	28.06	60	Nd	Neodymium	144.27
15	P	Phosphorus	31.02	61	Il	Illinium	—
16	S	Sulphur	32.06	62	Eu	Europium	150.43
17	Cl	Chlorine	35.457	63	Eu	Europium	152.0
18	Ar	Argon	39.94	64	Gd	Gadolinium	157.3
19	K	Potassium	39.104	65	Ter	Terbium	159.2
20	Ca	Calcium	40.07	66	Dy	Dysprosium	162.46
21	Sc	Scandium	45.10	67	Ho	Holmium	163.5
22	Ti	Titanium	47.90	68	Er	Erbium	167.64
23	V	Vanadium	50.95	69	Tu	Thulium	169.4
24	Cr	Chromium	52.01	70	Yb	Ytterbium	173.5
25	Mn	Manganese	54.93	71	Cp	Lutecium-Lu	175.0
26	Fe	Iron	55.84	72	Hf	Hafnium	178.6
27	Co	Cobalt	58.94	73	Ta	Tantal	181.5
28	Ni	Nickel	58.69	74	W	Tungsten	184.0
29	Cu	Copper	63.57	75	Re	Rhenium	188.7
30	Zn	Zinc	65.38	76	Os	Osmium	190.9
31	Ga	Gallium	69.72	77	Ir	Iridium	193.1
32	Ge	Germanium	72.60	78	Pt	Platinum	195.23
33	As	Arsenic	74.96	79	Au	Gold	197.2
34	Se	Selenium	79.2	80	Hg	Mercury	200.61
35	Br	Bromine	79.916	81	Tl	Thallium	204.39
36	Kr	Krypton	82.9	82	Pb	Lead	207.21
37	Rb	Rubidium	85.46	83	Bi	Bismuth	209.00
38	Sr	Strontium	87.63	84	Po	Polonium	210.0
39	Y	Yttrium	88.93	85	—	—	—
40	Zr	Zirconium	91.22	86	Rn	Radon (Nit.)	222.0
41	Nb	Niob	93.5	87	—	—	—
42	Mo	Molybdenum	96.0	88	Ra	Radium	225.97
43	Ma	Masurium	—	89	Ac	Actinium	230
44	Ru	Ruthenium	101.7	90	Th	Thorium	232.12
45	Rh	Rhodium	102.9	91	Pa	Uranium X=Ux	234
46	Pd	Palladium	106.7	92	U	Uranium	238.14

Physical and Technical Units

Term	Unit in the FPS System	Unit in the CGS System	Additional Units
A. Mechanical and Thermal Units.			
Length	Foot	Centimetre (cm)	Mille
Area	Square foot	Square centimetre (cm ²)	Square Mile
Volume	Cubic foot	Cubic centimetre (cm ³)	1 Gallon Kilogram
Mass	Pound	Grams	Minute, hour
Density	Pounds/cu. foot	Grams/cm ³	Miles per hour
Time	second	Second (s)	
Frequency	Cycles per sec.	Hertz (Hz)	
Velocity	Foot/sec	cm/sec	
Acceleration	Foot/sec/sec	metre/sec ² .	
Force	Poundal	cm × gram/sec ² (dyne)	
Torque, turning moment		cm ² × gram/sec ²	
Pressure	Pounds/sq. in.	gram/cm ²	1 Bar = 10 ⁶ dynes/cm ²
Modulus of elasticity		gram/cm sec ²	
Modulus of inertia		cm ² /gram	m ² × kg
Work, energy		cm ² × gram/sec ²	J (Joule), HP/hour
Quantity of heat		erg	cal (calorie)
Effect, power		cm ² × g/sec ²	HP, kW.
Temperature	Degrees Fahrn.	erg/sec Deg. centigrade	

TABLES

Term	Unit in the CGS System	Technical (Practical) Units	Additional Units
B. Electro-Magnetic Units			
Voltage, EMF		V (Volt)	millivolt, kV
Current		A (Ampere)	milliamp.
Quantity of Electricity		C (coulomb)	milliamp./sec.
Power		W (Watt)	Amp./hour
Reactive power		Var	
Apparent power		V. A.	kVA
Work (Energy)		Joule, Watt/hour	kW hour
Resistance		Ω (Ohm)	
Conductivity		S (Siemens)	
Magneto-Motive Power	Gilbert	Ampere Turns	
Mag. Field Strength	Oersted	Amp/cm	
Mag. Induction	G (Gauss)	V sec/cm ²	
Mag. Flux	M (Maxwell)	Wb (Weber)	
Inductance		H (Henry)	
El. Field Strength		V/cm	
Dielectric (Displacement)		C/cm ²	
Capacity		F (Farad)	F
C. Optical Units			
Luminous intens.			J (Candle-Power I. HK (Hefner-Kerze))
Luminous Flux			q (Lumen)
Quantity of Light		Candle/Lumen	Q (Lumen/hour)
Illumination		E (Candle-Foot)	Lx (Lux); 1 Phot = 1 Lm/cm ²
Surface Brightness		Lambert (1 Lm/cm ²)	HK/cm ²

Specific Resistance [Ω mm²/m]* and Coefficient of Temperature at 20° C.

TABLES

Material	Q 20	100 α 20
Aluminium	0.03—0.04	0.36
Aluminium bronze ²⁾	0.13—0.29	0.06—0.1
Aluminium wire ¹⁾	0.029	0.40
Arc Carbon	50—90	—
Bismuth	1.2	0.4
Brass Wire	0.07—0.08	0.13—0.19
Carbon Brushes	40—75	—
Copper (conductors ⁵⁾)	0.0178	0.392
Copper (windings)	0.0172	0.392
Coppered Carbon	—	—
Brushes	0.21—4.5	—
Gascoal	ab. 100	—0.03—0.08
German Silver	0.35—0.41	0.007
Gold	0.023	0.38
Graphite Brushes	12—40	—
Iron ³⁾	0.10—0.15	0.45
Iron, cast	ab. 0.6—1.6	—
Iron, sheet	0.13	0.45
Iron, sheet, alloyed ⁴⁾	0.27—0.67	—
Konstantan	0.59—0.51	—0.005
Lead	0.208	0.40
Manganin	0.42	+ 0.001
Mercury	0.958	— 0.090
Nickel	0.09—0.11	0.44
Nickel	0.4—0.44	0.018—0.021
Platinum	0.10—0.11	0.38—0.39
Silver	0.0165	0.36
Steel	0.10—0.25	0.45—0.5
Steel Wire	0.17	0.52
Tantalum	0.16	0.3
Tungsten	0.065	0.4
Tin	0.12	0.44
Zinc	0.063	0.37

1) 99.6% Al. content. — 2) Copper with 5 to 10% Al. content. — 3) 90.9 to 99% Iron content. — 4) 1.0 to 5% Sulphur content. — 5) Copper conductors according to German Standards should not have a greater $Q = .01784$ at 20° C. Specific gravity to be taken as 8.89 kg/dm³). High quality annealed copper according to International Standards (ETZ 1914, page 366) has at 20° C a $Q = .01724$, $\alpha = .000393 = 1/354.5$, specific gravity of 8.89 kg/dm³.

Small impurities may influence these values to a great extent!

For rough calculations of conductors a $Q = 1 : 53$ may be assumed for copper carrying electrical current; for electrical machinery $Q = 1 : 50$ to $1 : 46$.

UNITS OF ELECTRICITY

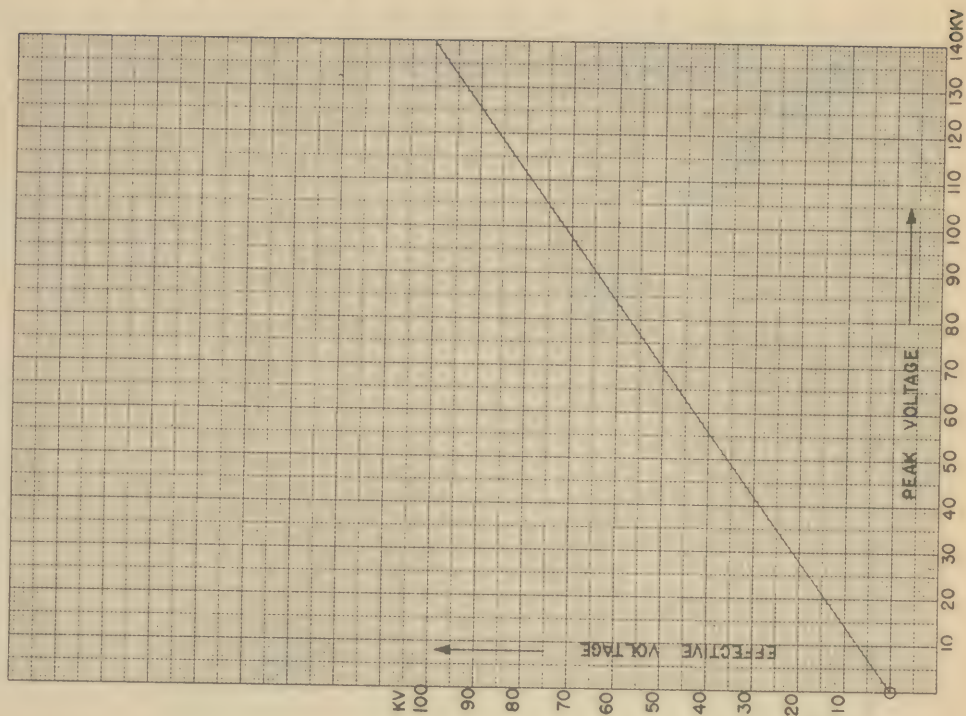
Term.	Technical Unit	Electro-magnetic Unit	Electro-static Unit
Quantity of electricity	1 Coulomb (C) = $\frac{1}{10}$ Electro-Mag. CGS Unit = 3×10^9 El.-Stat. CGS Units	10 Coulombs	$\frac{1}{3 \times 10^9}$ Cou- lomb
Current	1 Ampere (Amp.) (1 Milliampere, mA = $\frac{1}{1000}$ Amp.) = $\frac{1}{10}$ El.-Mag. CGS Unit = 3×10^9 El.-Stat. CGS Units	10 Amps.	$\frac{1}{3 \times 10^9}$ Amp.
Voltage (electro-motive force)	1 Volt (V) = $\frac{1}{10^8}$ El.-Mag. CGS Units = $\frac{1}{300}$ El.-Stat. CGS Unit	$\frac{1}{10^8}$ Volt	300 Volts
Resistance	1 Ohm (Ω) (1 megohm meg. $\Omega = 10^6$ ohms) = $\frac{1}{10^9}$ El.-Mag. CGS Units = $\frac{1}{9 \times 10^{11}}$ El.-Stat. Units	$\frac{1}{10^9}$ Ohm	9×10^{11} Ohms
Capacity	1 Farad (F) = 9×10^{11} El.-Stat. CGS Units i. e., 1 Farad = 9×10^{11} cms 1 microfarad (μ F) = $\frac{1}{10^6}$ F 1 Farad = 10^6 μ F	10^9 Farad	$\frac{1}{9 \times 10^{11}}$ Farad i. e.: 1 cm = 9×10^{11} Farad 9 cm = $\frac{1}{10^6}$ μ F $\frac{1}{10^{12}}$ F
Inductance	1 Henry (H) = $\frac{1}{10^9}$ El.-Mag. CGS Units = 9×10^{11} El.-Stat. CGS Units i. e.: 1 Henry = 10^9 cms.	$\frac{1}{10^9}$ H i. e.: 1 cm = $\frac{1}{10^9}$ H	9×10^{11} Henry
Electric Energy	= 1 Volt-coulomb = 1 Watt \times Second = $\frac{1}{10^7}$ El.-Mag. CGS Units = $\frac{1}{10^9}$ El.-Stat. CGS Units	$\frac{1}{10^7}$ Volt- Coulomb or joule	$\frac{1}{10^7}$ Volt- Coulomb or joule
Electric Power	= 1 Volt \times Ampere = $\frac{1}{10^7}$ El.-Mag. CGS Units = $\frac{1}{10^9}$ El.-Stat. CGS Units	$\frac{1}{10^7}$ Watt	$\frac{1}{10^7}$ Watt

1 Ampere hour = 3600 Coulomb
1 Ampere sec = 1 Coulomb
1 Watt = 1 Volt \times Ampere = 1 joule/sec
= $\frac{1}{10^7}$ HP = 10^2 mhg/sec = .24 gcal/sec
1 Kilowatt = 1000 Watts = 1.34 HP = .24 kg cal/sec
1 Watt-hour = 3600 joule = 2640 Foot-Lb./hours
1 Watt-sec = 1 joule = 44 Foot-Lb./mins
1 Kilowatt-hour = 1.34 HP \times hours = 894 kg cal

*) In physics specific resistance is usually defined with 1 in cms and q in cm². These values are therefore smaller by 104 as against those mentioned above. — Deviations in the values quoted are caused by the varying purity of the metals. —

Relation between the peak and the root mean square value of a sinusoidal alternating voltage

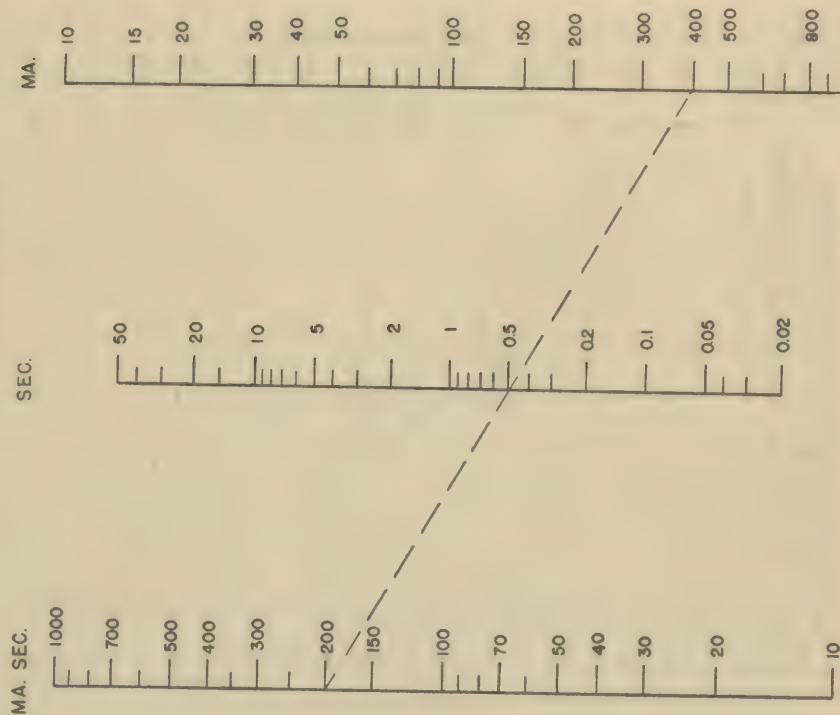
In modern radiology it is general practice to identify tube voltage with the peak value. With up-to-date equipment therefore, measuring instruments for tube voltage are calibrated in peak values. With older equipment apparatus these instruments are often calibrated in root mean square values. The peak value, KVP, of a sinusoidal alternating voltage is 1.414 times that of the root mean square value KV eff.



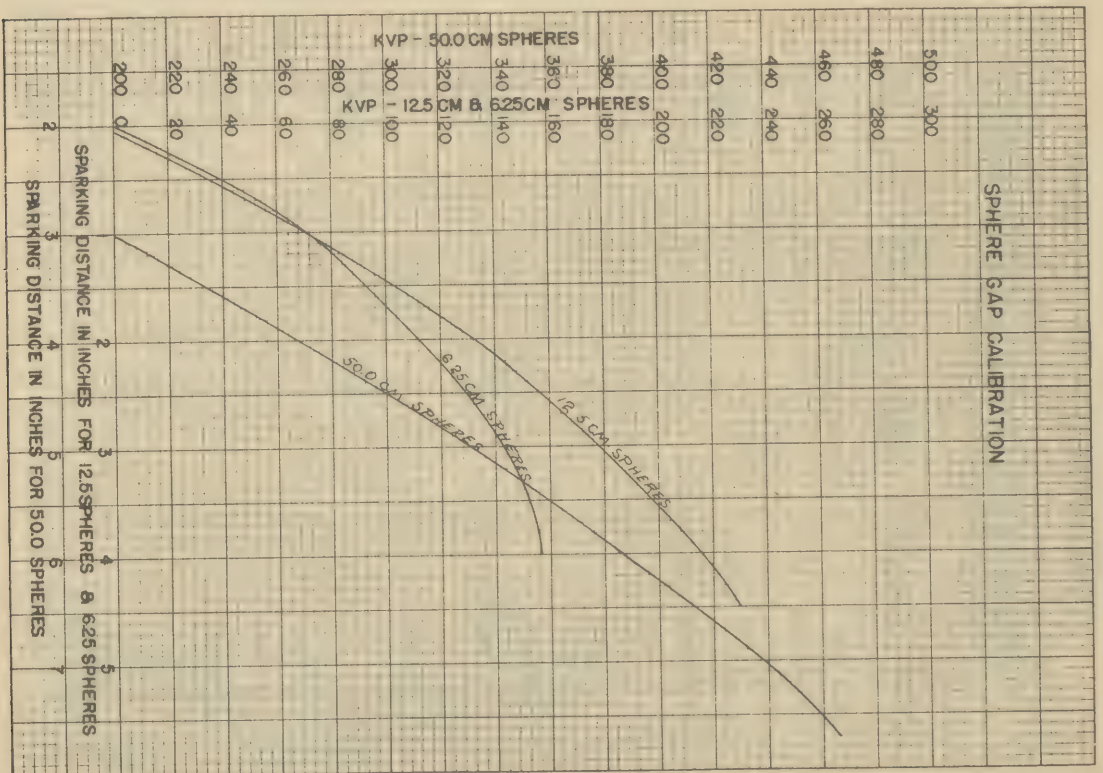
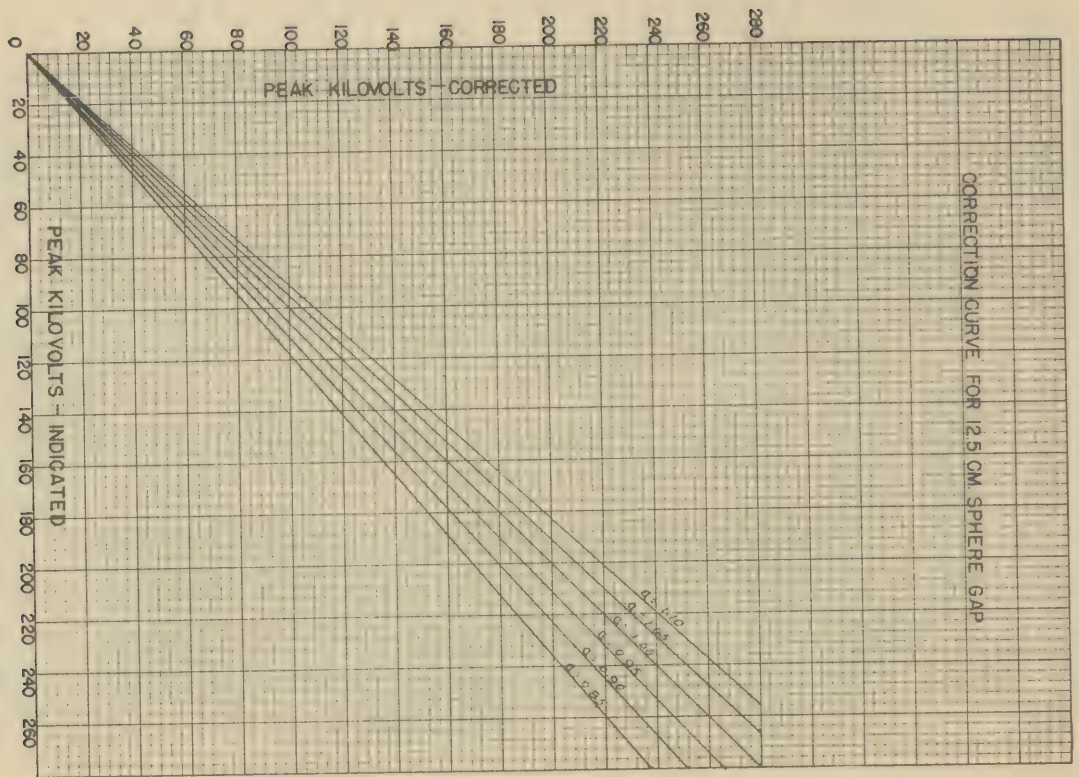
TUBE CURRENT — TIME NOMOGRAM

The nomogram below serves to resolve the mAs, product in the factors exposure time (in sec.) and intensity of tube current (mA's). A straight line connecting two factors will give the required quantity by its intersection with the third characteristic.

Example as shown in the nomogram:
200 mAs, are obtained with 400 mA's and 0.5 sec.



TABLES



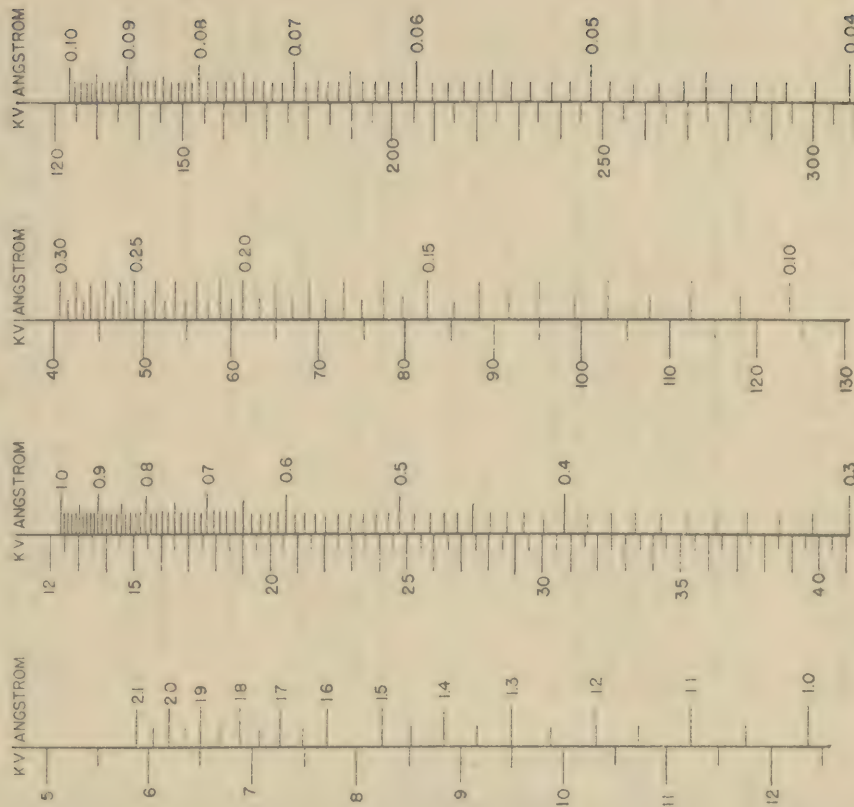
For Various Tube Voltages and Copper Filters:

Thickness of copper prestress in mm	Thickness of the half-value layer in mm copper with tube voltage kV of:						
	100	120	140	160	180	200	220
0.1	0.23	0.30	0.39	0.49	0.61	0.75	0.89
0.2	0.27	0.36	0.46	0.57	0.70	0.85	1.00
0.3	0.32	0.43	0.52	0.64	0.78	0.94	1.11
0.4	0.37	0.47	0.58	0.71	0.86	1.03	1.22
0.5	0.41	0.51	0.64	0.78	0.94	1.12	1.33
0.6	0.44	0.56	0.70	0.85	1.02	1.22	1.43
0.7	0.48	0.60	0.75	0.92	1.10	1.31	1.53
0.8	0.51	0.64	0.80	0.99	1.18	1.40	1.62
0.9	0.54	0.68	0.85	1.05	1.25	1.48	1.71
1.0	0.56	0.72	0.89	1.10	1.32	1.56	1.80
1.1	0.59	0.75	0.93	1.15	1.38	1.62	1.87
1.2	0.62	0.78	0.97	1.19	1.43	1.67	1.93
1.3	0.63	0.81	1.00	1.23	1.47	1.73	1.99
1.4	0.64	0.83	1.03	1.26	1.51	1.77	2.03
1.5	0.65	0.85	1.06	1.29	1.53	1.80	2.06
1.6	0.66	0.86	1.08	1.31	1.55	1.83	2.09
1.7	0.67	0.87	1.09	1.33	1.57	1.85	2.12
1.8	0.68	0.88	1.10	1.35	1.59	1.87	2.15
1.9	0.69	0.89	1.11	1.36	1.61	1.89	2.17
2.0	0.70	0.90	1.12	1.37	1.63	1.91	2.19

These values are valid for X-ray tubes with tungsten anode energized with constant D. C. potential. The "half-value" layer values are approx. 10% lower for apparatus with a Villard circuit.

WAVE LENGTH λ_0 OF X-RAY RADIATION
AND PEAK TUBE VOLTAGE KVP

ACCORDING TO DUANE AND HUNT λ_0 IN Å-UNITS



THESE TABLES PERMIT THE DETERMINATION OF THE CORRESPONDING VALUES OF λ_c AND KVP

THE DEFINITION OF X-RAY QUALITY IN TERMS OF THE HALF-VALUE LAYER

The qualitative diagram shows the relation between tube maximum voltage, filter and the half-value layer in the case of an equivalent thickness of the tube glass to 3 mm Aluminum. (With heavy filtration the thickness of the tube glass need not be taken into account.)

The diagram has been obtained from results with constant voltage apparatus, but may also be applied with sufficient accuracy to apparatus with pulsating voltage.

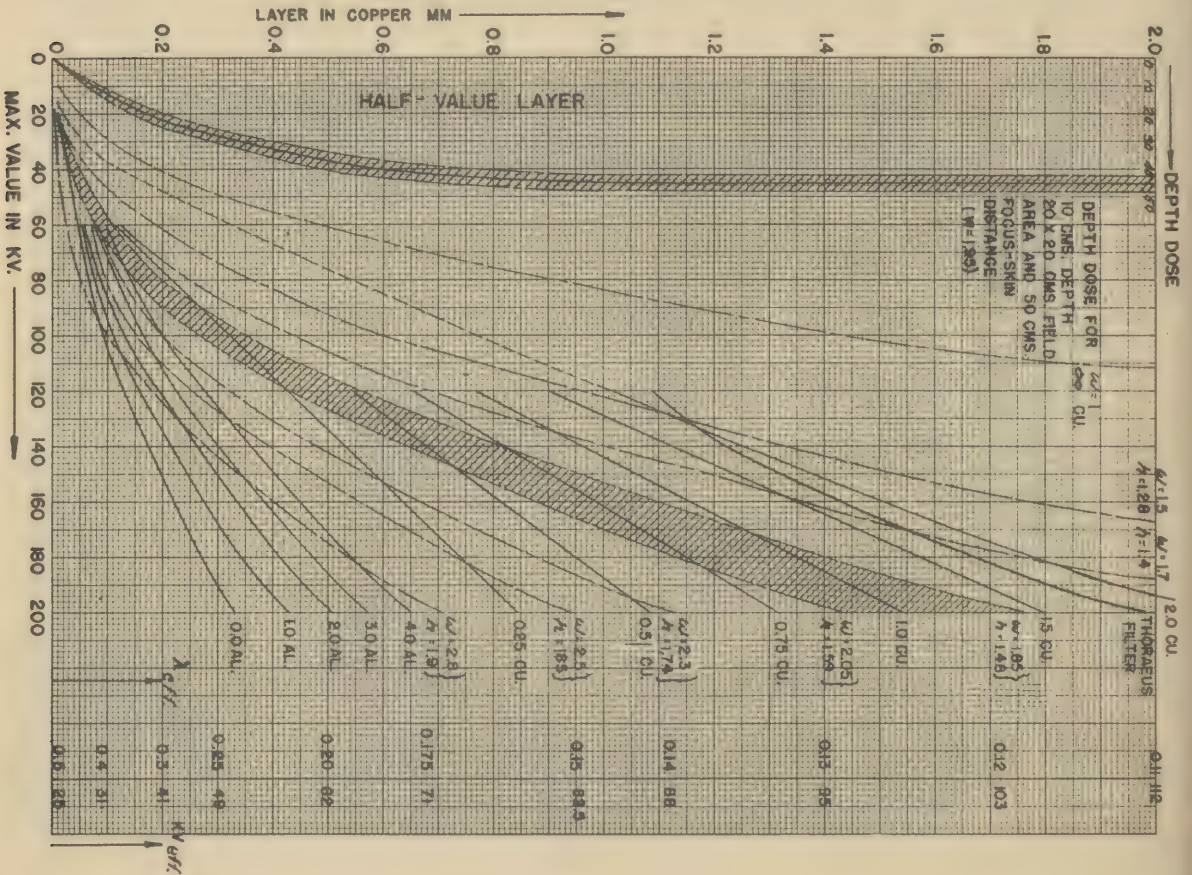
The abscissa shows the maximum values of the tube voltage, the ordinate the "half-value" layers in copper.

Upon a parallel to the ordinate, on the right, may be found the value of the effective wavelengths (λ_{eff}) calculated according to the absorption formula and corresponding to the "half-value" layers; also the values of the mean average tube voltage (kV_{eff}) computed by means of the Duane-Hunt formula.

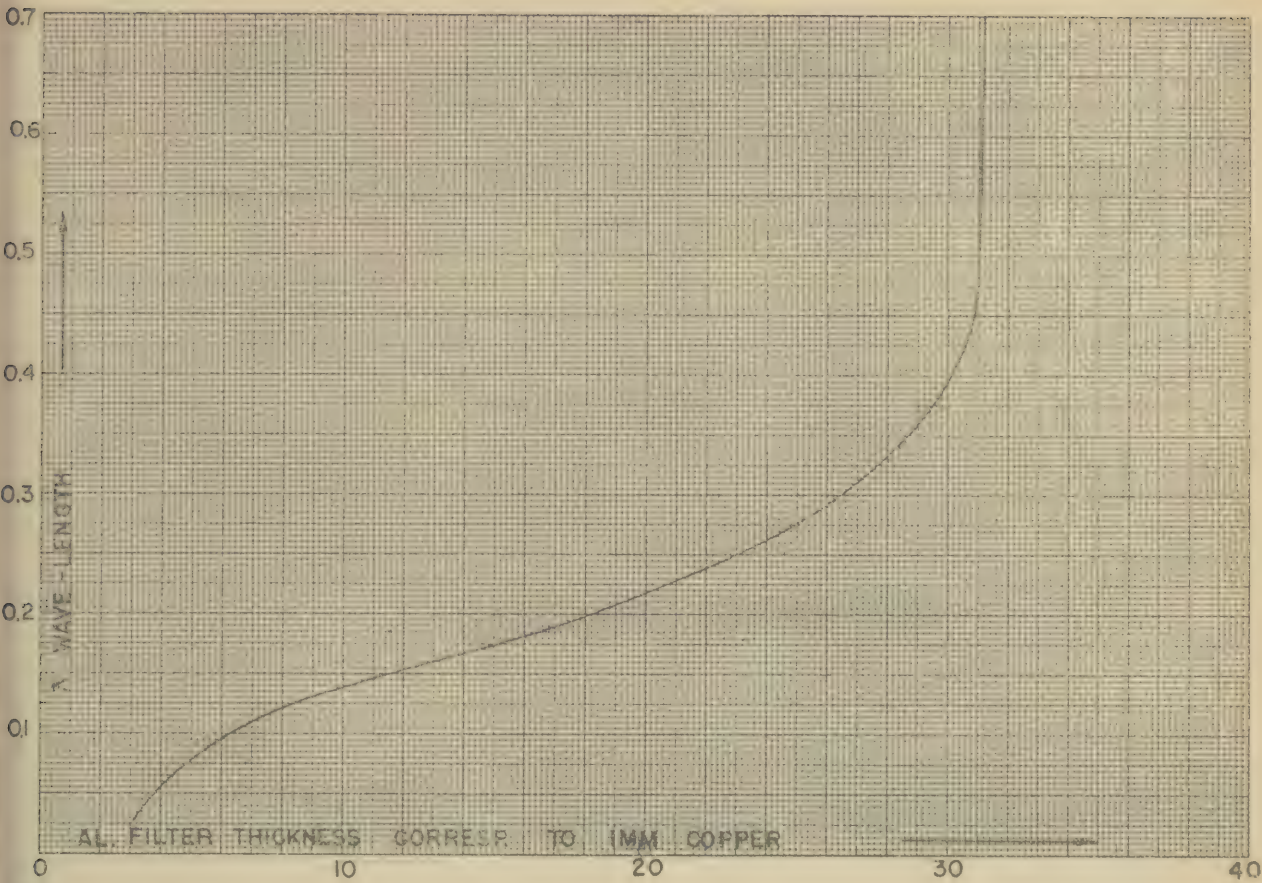
The solid line curves for various filtration with copper and aluminum and the Thoreaus filter show the increase of the "half-value" layer with the voltage.

The dash-dotted curves are isohomogeneous curves, i. e. they connect points of similar homogeneity. The degree of homogeneity may be indicated either by the relation h between the first and second "half-value" layer or by the relation w between the effective and the shortest wavelength. The dash-dotted curve on the left ($w = 1$) corresponds to the value of the "half-value" layer for infinitely heavy filtration. Radiation with an average, practically sufficient degree of homogeneity are to be found in the shaded section (w approx. 2).

The depth dose in a water phantom at a depth of 10 cms practically corresponding to this section for 50 cm focal distance and 20×20 cms field area may be seen in the first curve shown to the left.



QUALITATIVE DIAGRAM



ALUMINUM AND COPPER FILTERS

Determination of the thickness of an Aluminum Filter corresponding with a copper filter of given size regarding its ray filtering properties.

The thickness of the required aluminum filter may be immediately ascertained from the curve corresponding to a copper filter of 1 mm. in its effectiveness.

Example: The thickness of a copper filter to be found corresponding to a 3 mm. Aluminum layer with similar properties towards radiation of a wave length of .3 A.-Units.

From the curve it is found that at .3 A.-Units 27 mm. Aluminum are equivalent to 1 mm. of copper; therefore a copper filter of 1.9 mm. corresponds to a 3 mm. Aluminum filter.

Since the filter value changes with the wave length, a mean wave length may inversely be obtained for non-homogeneous radiation by determining the thicknesses of Aluminum and copper filters of equal ray filtering properties by means of direct dosage measurements. The mean wave length may then be defined as the wave length of a homogeneous radiation weakened in the same manner as the given non-homogeneous radiation.

FILTER COMPARISON

SECTION LIX

PHILLIPS 100 MA

SECTION LIX

PHILIPS 100 MA

UNPACKING AND ASSEMBLY OF APPARATUS

UNPACKING - The apparatus is packed in three cases. These cases are marked and contain the following:

1. Generator
2. Control
3. X-Ray tube, high tension cables, mounting cone, Bucky cord, other miscellaneous parts (if needed).

The cases should be opened carefully and the material inside removed and examined. If any breakage is found, notify the Medical Supply, or other responsible officer.

Examine all packing carefully to make certain that no parts are left in the case or the packing.

ASSEMBLY - Move the control into the x-ray room and place in position in its final location. Remove the ropes binding the cables. Place the transformer in its final position. Remove back panel of control. Remove transformer cover.

ELECTRICAL CONNECTIONS OF APPARATUS

POWER SUPPLY REQUIREMENTS - The electrical service for this equipment shall conform to the following specifications:

- 208-240 volts, 60 cycles
- 60 amperes capacity (minimum)
- Externally operated safety switch with solid neutral (Underwriters' Laboratories approved)

The recommended wire size for a run not exceeding 50 feet is #4; for a run not exceeding 100 feet, #2; for a run not exceeding 200 feet, #0.

CONNECTION OF LINE CABLE (#15124A-20) - Connect L1 and L2 to the 220 volt supply. Connect G to the neutral.

CONNECTION OF CONTROL CABLE (15122A-15) - The cable is connected properly within the control cabinet. The lugs on the transformer end are stamped to correspond with the markings on the transformer junction block and terminal block.

1. Control cable lugs are stamped for identification. Connect the lugs marked G, F1, F2, FX, and M to the corresponding studs of the transformer terminal block. The terminals of this block are connected to the transformers, etc. in the tank. Do not connect P1 and P2.
2. The transformer junction block is a six-terminal assembly which serves to provide connections from the control cable to the various accessories, such as Buckys, foot switch etc.

The normal connections are as follows:

Transformer Junction Block Terminal No.	Control Cable Lug	Accessory Device Lug
11	FS1	FS1)
12	FS2	FS2) Foot Switch

PHILIPS 100 MA

Transformer Junction Block Terminal No.	Control Cable Lug	Accessory Device Lug
13	BR1	BR1) Bucky Release
14	BR2	BR2) Magnet
15	BC1	BC1) Bucky Contact
16	BC2	BC2)

ACCESSORY CONNECTIONS

1. FOOT SWITCH - Foot Switch leads FS1 and FS2 connect to terminals 11 and 12 respectively.
2. BUCKY CONNECTIONS - A 4-wire cable is provided with the apparatus and is terminated at one end with a standard 4-contact female attachment plug that fits into the receptacle provided on the Bucky.
3. BUCKY RELEASE MAGNET

BR1 - Green Lead
BR2 - Red Lead

These energize the Bucky release magnet. Connect to terminals 13 and 14 of the transformer junction block.

4. BUCKY CONTACTS

BC1 - White
BC2 - Black

These connect the Bucky contacts. Connect to terminals 15 and 16 on the transformer junction block.

Bind the Bucky cord and the foot switch cord, and any other cords together with friction tape and secure underneath the smaller clamp provided on the transformer.

X-RAY TUBE INSTALLATION - Attach the mounting cone to the x-ray tube. Make certain that the four screws that hold the cone to the tube are firmly tightened. Install the x-ray tube on the tubestand, and fasten securely to stand.

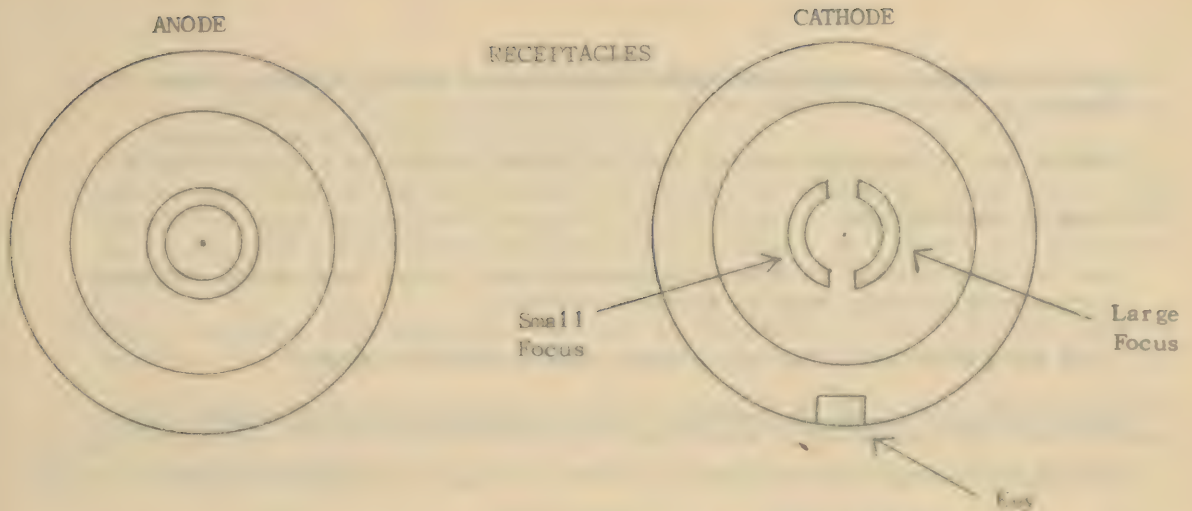
The high tension cables for the x-ray tube are provided with Philips terminals, Type 15063 on the transformer side. Both anode and cathode terminals are identical, except that the anode terminal is provided with a spring that short circuits all three contacts.

The connections of the contacts are shown on the following page.

INITIAL CHECK OF APPARATUS - P1 and P2 are not yet to be connected. Check all meter scales and rest meter needles to zero if they have shifted during transportation. Turn W22, combined main switch and circuit breaker, on. TURN MA SELECTOR SWITCH TO "FLUOROSCOPY".

KILOVOLT METER - Registers pre-read high tension primary setting. Rotation of kilovolt regulator knob will permit change in setting.

PHILIPS 100 MA



FILAMENT COMPENSATION METER - reads .2 - .3. It can be changed by adjusting filament compensation control.

FOOT SWITCH - Controls high tension.

TIMER PUSH BUTTON - No control.

TURN MA SELECTOR SWITCH TO "LOW MA".

KILOVOLT METER - drops back approximately 5 Kv.

FILAMENT COMPENSATION METER - reads a higher setting than on "Fluoroscopy". Control by filament compensation knob.

FOOT SWITCH - No control.

TIMER PUSH BUTTON - Controls exposure.

TURN MA SELECTOR SWITCH TO "HIGH MA".

KILOVOLT METER - drops back approximately 5 Kv.

FILAMENT COMPENSATION METER - Reads to a higher setting than on "Fluoroscopy" or "Low Ma". Control by filament compensation knob.

FOOT SWITCH - No control.

TIMER PUSH BUTTON - control exposure.

Connect P1 and P2. Repeat the above. The following tube currents will be read with a 4/10 KW Philips tube (or a 10 KW Philips tube):

Fluoroscopy (small focus for double focus tube) - 2-6 Ma
 Low Ma (small focus for double focus tube) - 20-30 Ma
 High Ma (large focus) - 100 Ma

TUBE CURRENT ADJUSTMENTS

1. FLUOROSCOPY - Set the Ma selector switch W3 to FLUOROSCOPY position.

PHILIPS 100 MA

Set the filament compensator R5 with the pointer facing directly toward the timer.

Adjust the kilovoltage control knob to 65 KvP reading on kilovoltmeter M1.

Step on foot switch.

Set the tube current to 3 Ma by adjusting lower slider band of R2. Move up to increase current, down to decrease current.

2. "LOW MA" (20-30 Ma) - Set Ma selector switch, W3, to low Ma.

Leave filament compensator R5 set to previous position (3 Ma Fluoroscopy).

Adjust kilovoltage control knob to 65 KvP reading on kilovoltmeter M1.

Set radiographic timer to one second.

Press push button W10.

Adjust upper slider on R2 to 20 or 30 Ma as desired by changing its position if necessary. Move up to increase Ma, down to decrease Ma.

3. "HIGH MA" (50-100) - Set Ma selector switch W3 to "High Ma".

Leave filament compensator R5 set to the previous position (3 ma Fluoroscopy).

Adjust kilovoltage control knob to 65 KvP reading on kilovoltmeter M1.

Set radiographic timer to $\frac{1}{2}$ second.

Press push button W10.

Adjust slider on R8 to desired milliamperage. Move up to increase Ma, down to decrease Ma.

4. MILLIAMPERAGE-KILOVOLT COMPENSATION - The tube current will tend to rise as the kilovoltage is decreased. This effect is compensated by adjustment of the taps on resistor R9. Selection of these taps is automatically made for various kilovoltages by switch W18, which is mechanically connected to the autotransformer slider.

Procedure of adjustment is as follows:

Set Ma selector switch W3 to "Low Radiography" - 20-30 Ma.

Set kilovoltage to 65 KvP.

Press radiographic push button W10 and read Ma. Ma should read correctly due to previous adjustment.

Set kilovoltage to 90 KvP and check milliamperage. Adjust milliamperage by moving top slider on resistor R9.

Set kilovoltage to 75 KvP and check milliamperage. Adjust milliamperage by moving the third slider from the bottom on resistor R9.

PHILIPS 100 MA

Set kilovoltage to 45 KvP and again read milliamperage. If milliamperage is off adjust bottom slider on resistor R9 and test until proper milliamperage is obtained at this voltage.

NOTE - With certain types of tubes, it may not be possible to get enough compensation range in the above manner. In this event, move the top slider band on R9 one-half inch toward the top of the resistor and repeat the procedure outlined above.

NOTE - Normally this adjustment is made at the factory before shipment, and it may not be necessary in the field.

KILOVOLTAGE ADJUSTMENT - The apparatus is designed so that with 220 volts input to the transformer primary the following kilovoltages are obtained with the various Ma settings of the tube:

Tube Milliamperage	Transformer Primary Voltage	High Tension Secondary Voltage
3 Ma	220 volts	100 KvP
30 Ma	220 volts	93 KvP
50 Ma	220 volts	90 KvP
100 Ma	220 volts	85 KvP

Read the primary voltage on terminals 1 and 3 on the autotransformer connection block, located on top of the autotransformer.

1. **FLUOROSCOPY** - Set Ma selector switch W3 to "FLUOROSCOPY".

Adjust kilovoltage regulator to 220 volts.

Check the reading on kilovoltmeter M1. If it does not correspond with the above values adjust upper slider band of R11 until the correct kilovoltmeter reading is obtained.

2. **"LOW MA"** - Set Ma selector switch W3 to "Low Ma".

Adjust kilovoltage regulator to 220 volts.

Check reading on kilovoltmeter M1. If it does not correspond to the above values adjust the middle slider of R11 until the correct kilovoltmeter reading is obtained.

3. **"HIGH-MA"** - Set Ma selector switch W3 to "High Ma".

Adjust kilovoltage regulator to 220 volts.

Check reading on kilovoltmeter M1. If it does not correspond, adjust the lower slider band of R11 until the correct kilovoltmeter reading is obtained.

If the user finds the radiographs taken are not entirely to his satisfaction using his normal technique, it is possible the abnormal voltage drop causes this discrepancy. In this case it is suggested that test radiographs be taken using normal technique, using kilovoltage determined by thickness of part. Resistor R11 should then be adjusted until kilovoltmeter registers nominal kilovoltage as determined radiographically.

PHILIPS 100 MA

DESCRIPTION OF CIRCUIT DIAGRAM

CLASSIFICATIONS OF PARTS - The purpose and the functioning of the principal parts of the apparatus are explained in brief below. Each part is indicated in this explanation and in the diagrams, by letters and figures that correspond. Parts of the same fundamental construction are marked with the same letter for the purpose of simple identification. The following is the classification:

- Class S - contactors, relays, etc.
- " W - Switches, etc.
- " R - resistors
- " TR - transformers, impedances, etc.
- " C - capacitors
- " M - measuring instruments, meters, etc.

CLASS S - CONTACTORS, RELAYS, ETC.

- S1 - CONTACTOR for high tension primary.

CLASS W - SWITCHES, ETC.

- W1 - BUCKY CONTACT timing selector switch. Permits the operator to use the Bucky timing device or the radiographic timer to control radiographic exposures. When the radiographic timer is used for control of exposures the Bucky timing must be set slightly longer than the radiographic timer to make and break the high tension.

In the "OFF" position the radiographic timer may be used for control of the exposures.

In the "ON" position the Bucky timer controls the exposures.

- W3 - MA SELECTOR SWITCH consists of four decks, identified as 1, 2, 3, and 4 on Drawing 17029.

For Fluoroscopy:

- Deck 1 connects 20 Ma scale of milliammeter M2.
- Deck 2 connects to fluoroscopic tap of filament resistor R2.
- Deck 3 connects foot switch into high tension control circuit.
- Deck 4 compensates kilovoltmeter M1 for fluoroscopic milliamperage.

For Low Ma (Radiography)

- Deck 1 connects 100 Ma scale of milliammeter M2.
- Deck 2 connects to low radiographic tap of filament resistor R2.
- Deck 3 connects timer contact W20 into control circuit.
- Deck 4 compensates kilovoltmeter M1 for low radiographic milliamperes.

For High Ma (Radiography)

- Deck 1 connects 100 Ma scale of milliammeter M2.
- Deck 2 connects to filament resistor R8.
- Deck 3 connects timer contact W20 into control circuit.
- Deck 4 compensated kilovoltmeter M1 for high radiographic milliamperes.

- W9 - BUCKY RELEASE BUTTON permits remote operation of Bucky for Bucky exposures.

PHILIPS 100 MA

- W10 - RADIOGRAPHIC PUSH BUTTON operates timer for non-Bucky radiographic exposures.
- W11 - turns all pilot lights on and off.
- W18 - KILOVOLT-MILLIAMPERAGE COMPENSATOR SWITCH. It is mechanically connected to the kilovolt adjustment slider of TR1. Four switching sections are provided, and each of these is connected to a corresponding tap on R9. The position of the kilovoltage adjustment slider determines which resistance tap is to be connected in to the filament primary circuit in use.
- W20 - EXPOSURE CONTACT of radiographic timer. Operates magnetic coil of contactor S1.
- W22 - SAFETY RELEASE in case of breakdown or overload.

CLASS R - RESISTORS

- R1 - SWITCHING RESISTANCE in high tension primary circuit. Eliminates high tension surges when energizing transformer primary.
- R2 - FILAMENT RESISTOR preset for low radiography (20-30 Ma) and fluoroscopy.
- R8 - FILAMENT RESISTOR preset for high milliamperage radiography.
- R5 - VARIABLE FILAMENT CONTROL RESISTOR for control of fluoroscopic milliamperage.
- R9 - MILLIAMPERAGE-KILOVOLT compensation resistor. Maintains tube milliamperage constant throughout entire range of kilovolt operation.
- R11 - Compensates kilovoltmeter reading for various milliamperage leads.

CLASS TR - TRANSFORMERS, IMPEDANCES, ETC.

- TR1 - AUTOTRANSFORMER SECTION for adjustment of kilovoltage.
- TR2 - AUTOTRANSFORMER SECTION for line voltage compensation.
- TR3 - six-volt PILOT LIGHT SUPPLY TRANSFORMER.
- TR4 - Pre-reading peak kilovoltmeter compensation transformer.
- TR5 - CONSTANT VOLTAGE TRANSFORMER for filament circuit.

CLASS C - CAPACITORS

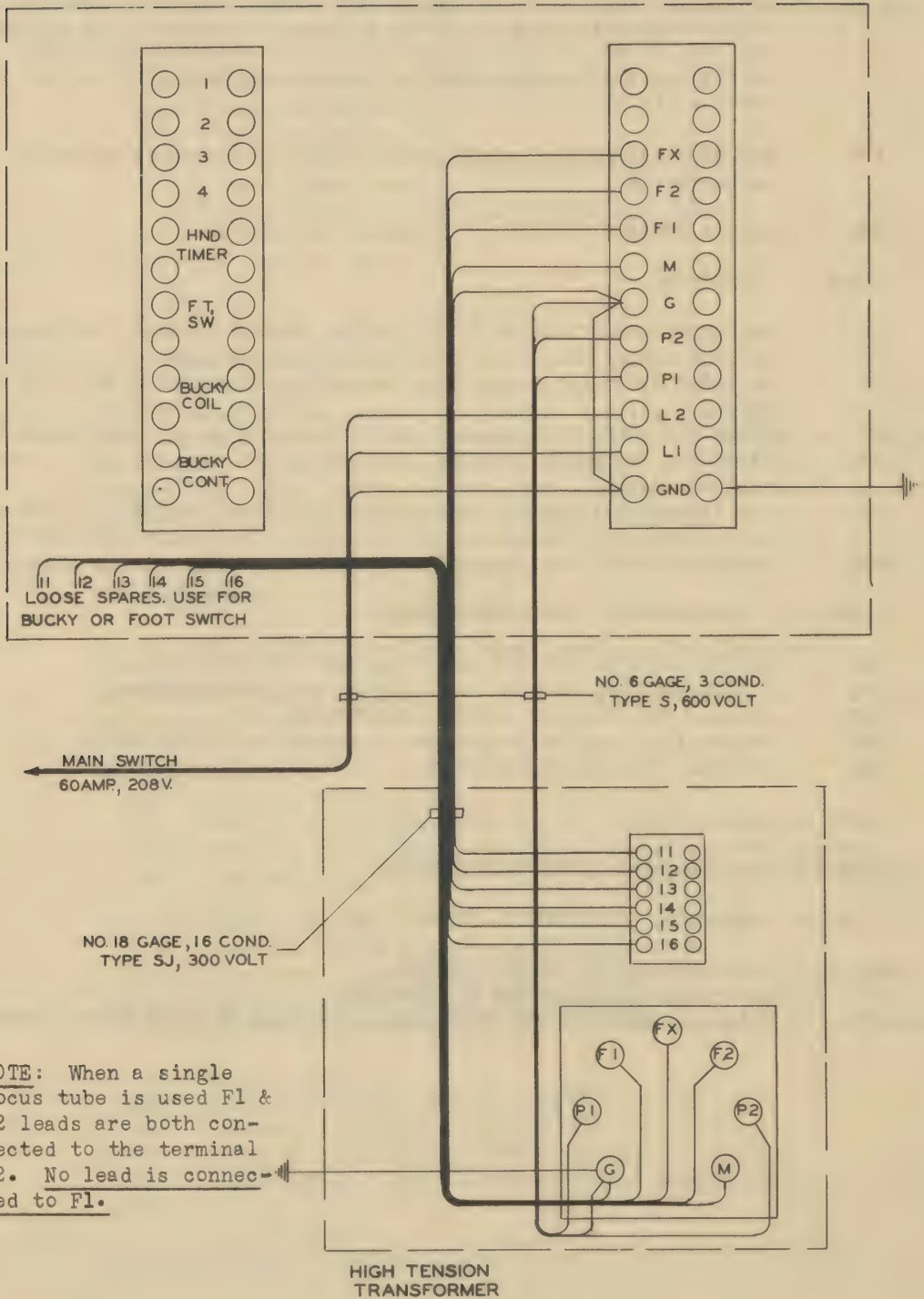
C3 & C4- High frequency BYPASS CONDENSERS.

CLASS M - MEASURING INSTRUMENTS, METERS, ETC.

- M1 - Pre-reading PEAK KILOVOLTMETER.
- M2 - Dual-range TUBE CURRENT MILLIAMETER.
- M3 - Filament COMPENSATION METER for presetting of x-ray tube filament.

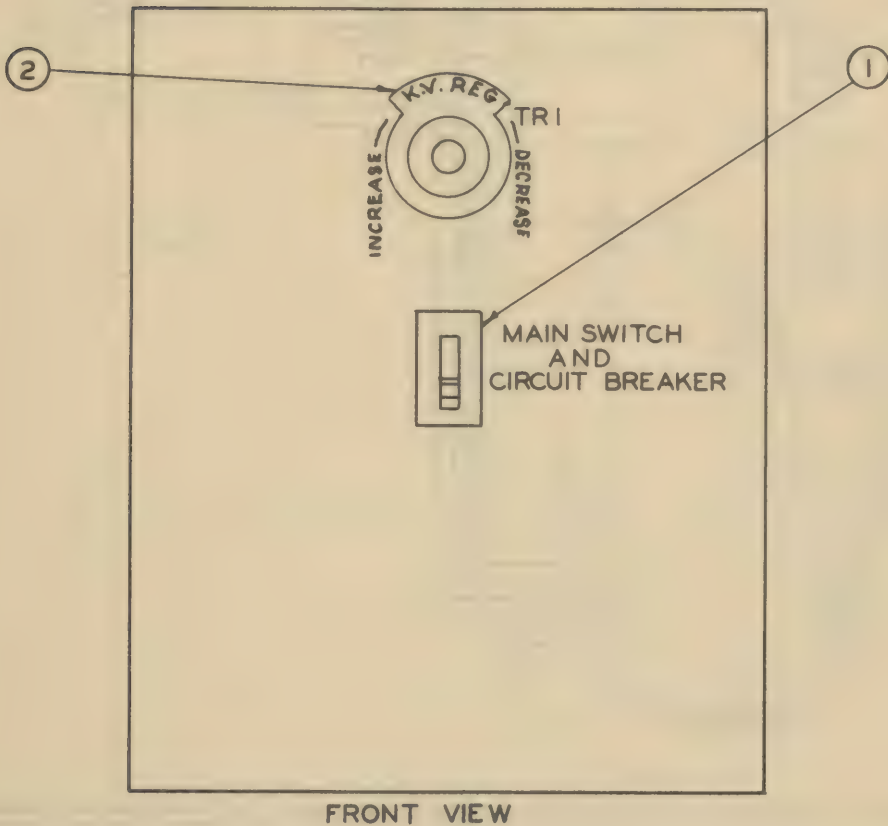
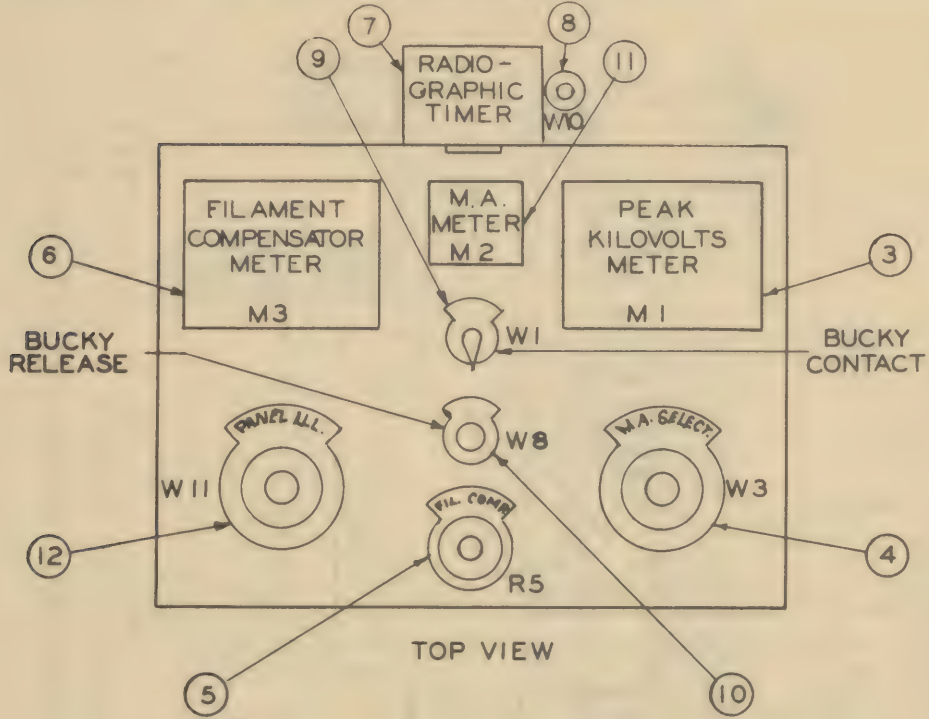
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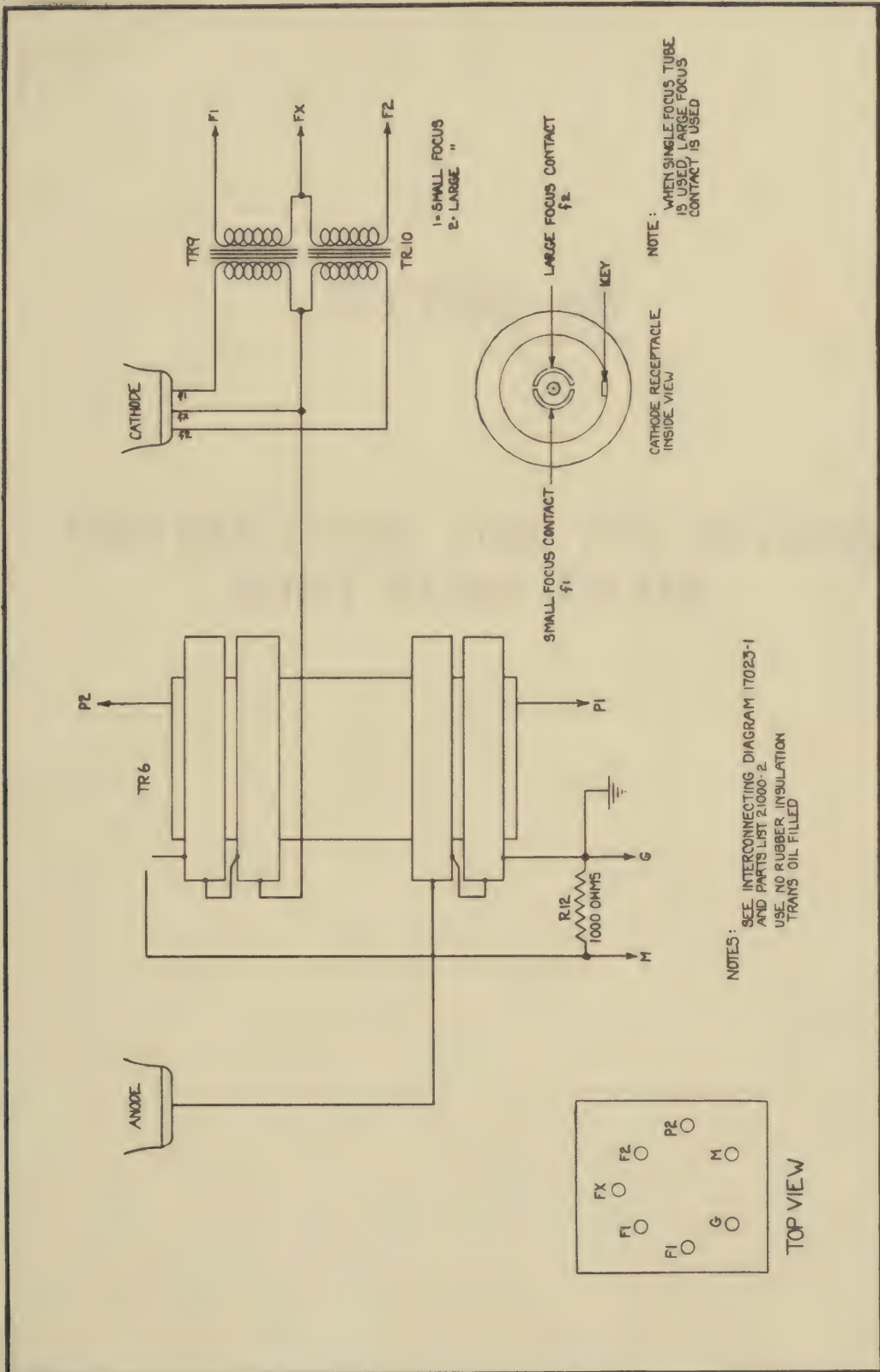
CONTROL STAND
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PH105 STANDARD CONTROL STAND

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SECTION LX

INSTRUCTIONS FOR THE RITTER FOOT PUMP CHAIR

THE UNIVERSITY OF CHICAGO

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INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

IMPORTANT

1. Carefully read the instructions contained in the instruction book packed with the chair, before mounting and operating the Ritter Chair.
2. Do not destroy this book. Put it in a convenient place, as you may want to refer to it again.
3. In unpacking the chair, take care to see that the tools employed are not used carelessly so as to injure the upholstery or finished parts.
4. Care must also be taken in removing and handling the various parts in order that the finished parts may not be scratched or chipped.
5. Carefully read the instructions for mounting the Base.
6. Follow carefully the instructions on the oiling of the various parts of the chair.

UNPACKING

The Ritter Chair as dismantled for packing and shipping consists of six parts, packed in a single case, viz.:

	The Base
	The Seat Frame
	The Foot Rest
One Box	The Upholstered Seat
	The Upholstered Back
	The Head Rest

The cover and ends of the shipping case are nailed, while the supports for holding the various parts of the chair in place are secured by means of screws to the sides of case.

The upholstered seat, the back cushion and the head-rest are fastened to the cover and ends of the case, as are likewise a can of oil and a small package of accessories.

The first step in unpacking is to place the case in an upright position and remove the top and ends, taking care to see that the tools employed are not used carelessly so as to injure the upholstery or finished parts. Care must also be taken in removing and handling the various parts in order that the surfaces may not be scratched or chipped.

Now remove the screws from the two uppermost supports and lift out the seat frame. Unscrew the next two supports and remove the foot-rest; do not remove the wooden block attached to foot-rest until ready for mounting. The base may now be removed, the paper covering being allowed to remain in place until ready to attach the seat frame.

With the exception of the base, all parts should now be unwrapped and each part thoroughly dusted, after which remove all packing material from room.

MOUNTING

THE BASE - Remove wrapping paper from top of base, taking care to see that no packing debris or other foreign substance enters cylinder. Wipe the top of

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR



Figure 1

cylinder and guide tubes and pour contents of oil can into the opening as shown in Figure One. Never use more than five pints, or any oil except that provided for the purpose.

CHAIR OIL - The oil supplied for raising and lowering of chair is especially prepared to withstand extreme variations in temperature; being a mineral product it will not become rancid or gummy and will maintain a suitable viscosity at all temperatures.

All air should now be expelled from pump through the vent controlled by the small screw which will be seen within Inner Guide Tube, No. 16, (Figure Two). Unscrew this one turn, taking care never to force it beyond the point to which it turns easily. *This is very important.* Now gently work Raising Lever, No. 27, (Figure Two) for about a minute or until all imprisoned air is released, and oil starts to overflow, return air vent screw to its original position

immediately and the base should be in working order. Air vent screw must be screwed down tight with large screw driver to prevent leaking.

SEAT FRAME - By means of Raising Lever, No. 27, (Figure Two), elevate the guide tubes until the inner tube is about three inches above top of cylinder, and attach the seat frame to the top of the Inner Guide Tube, No. 16, (Figure Two).

When locating seat on guide tube, see that end of tilting bar (the small bar which protrudes below the lower front edge of seat frame) is directly over the name plate on base. Locate holes in seat frame with holes in top of Inner Guide Tube, No. 16, and fasten with the four cap screws, which together with a socket wrench, will be found attached to one side of shipping case. It will be necessary to have a second person hold the seat frame in position until all screws are in place. These screws must be turned down tight with the socket wrench provided.

COMPENSATING SLIDE AND LOCK - The upper end of Compensating Slide, No. 36, (Figure Two), should now be attached to Back Frame, No. 15. Loosen Set Screw, No. 1, in top end of Compensating Slide; remove pin, No. 11; place slide in proper position with lugs on back frame and insert pin, No. 11, holding it in place by tightening set screw No. 1. (See Figure Two.)

HEAD-REST - To attach the Head-Rest, insert Head-Rest Slide, No. 9, (Figure Two), into channel in Back Slide, No. 12, and push it down so that small plunger on its inner side strikes obstructing edge of back slide casting. With a screw driver or any blunt instrument force this plunger back, at the same time pulling up on Lever, No. 10, until slide drops into position.

BACK CUSHION - Loosen set screw in under side of lug at top of Back Cushion frame and remove pin, No. 5, (Figure Two). Place Back Cushion in position, as shown in Figure Two; insert pin, No. 5, and hold it in place by tightening set screw.

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

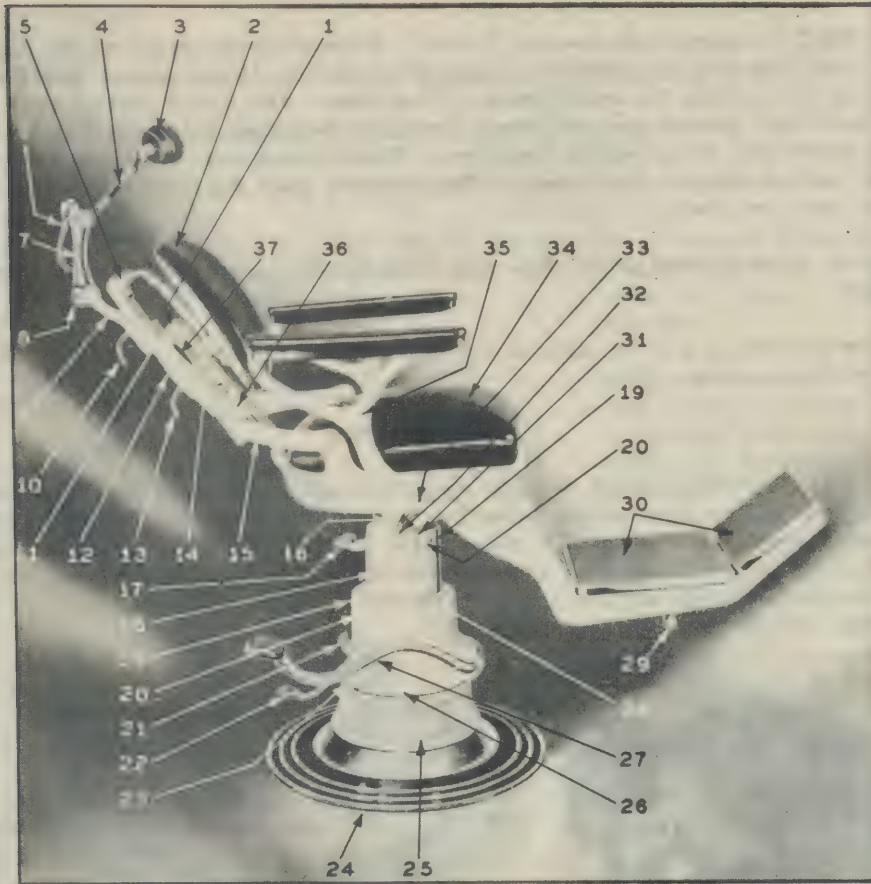


Figure 2

KEY FOR FIGURE 2

- | | |
|---|--|
| 1. Set Screw for Holding Pin. | 18. Outer Guide Tube. |
| 2. Back Cushion and Frame. | 19. Jamb Screws for locking Adjusting Screws. |
| 3. Head-Rest Pads. | 20. Adjusting Screw, for taking up wear on Guide Tube. |
| 4. Head-Rest Yoke. | 21. Rotary Lever. |
| 5. Pin, connecting Back Cushion Hanger to Back Slide. | 22. Lowering Lever. |
| 6. Head-Rest Locking Lever. | 23. Speed Regulator. |
| 7. Supporting Post for Head-Rest Yoke. | 24. Base Plate. |
| 8. Adjusting Nut for Head-Rest Locking Device. | 25. Oil Reservoir. |
| 9. Head-Rest Slide. | 26. Cylinder. |
| 10. Head-Rest Slide Lever. | 27. Raising Lever. |
| 11. Pin, connecting Compensating Slide to Back Support. | 28. Cylinder Cover. |
| 12. Back Slide. | 29. Foot-Rest Lever. |
| 13. Back Slide Lever. | 30. Foot-Rest. |
| 14. Pin, for connecting Cushion Frame to Hanger. | 31. Guide Tube Cover. |
| 15. Back Support Frame. | 32. Arm Clamp Lever. |
| 16. Inner Guide Tube. | 33. Tension Screw for adjusting Arm Clamp. |
| 17. Tilting Lever. | 34. Seat Cushion. |
| | 35. Arm. |
| | 36. Compensating Slide. |
| | 37. Back Lock Lever. |

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

FOOT-REST - Remove the wooden block. Elevate the chair about 4" and using the block just removed to raise it about 2" from the floor, place the Foot-REST in position for attaching to seat frame. Now lower the chair until seat frame and Foot-REST meet and fasten the two parts securely together by means of the four bolts with which block was attached to Foot-REST. These bolts must be turned securely into place with socket wrench furnished. The washers used to hold wood block in place must not be used on chair.

Drop the upholstered seat, No. 34, (Figure Two), into place and the assembly is completed.

The chair should now be placed in its proper relative position to the Unit, and it is ready for use.

MAINTENANCE

PUMP - Any trouble which may be experienced with the lifting mechanism can usually be remedied by depressing Lowering Lever, No. 22, (Figure Two), at the same time working Raising Lever, No. 27, vigorously for a few seconds. This will force a continuous flow of oil through the valves and have a tendency to dislodge any foreign substance which may be preventing their proper operation. In case this should prove ineffectual remove pump.



Figure 3

REMOVING PUMP - When removing pump proceed as follows:

1. Elevate chair half way and remove seat cushion.

2. Take out four bolts holding top and remove chair top from base. A second person should hold seat frame while bolts are being removed.

3. Release rotary locking lever and with guide tubes pumped up half way, lift cylinder out of reservoir. Figure "3" shows proper way to take hold of base.

4. Allow oil to drain from bottom of cylinder by resting it on edge of reservoir. See Figure "4".

5. Remove speed regulator by unscrewing with a screw driver.

6. Remove trip rod plate by taking out small screw which holds it to bottom end of large guide tube. See Figure "4".

7. Open air vent inside upper end of small guide tube and place receptacle to catch any oil that might escape from this point. Only one turn is re-

quired to open air vent. Do not turn further.

8. Remove four bolts holding pump to bottom of cylinder.

9. Press down on main lever. The tension thus placed on pump spring will

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

release pump from chair cylinder.

10. After releasing pump from cylinder pull it straight out.

REPLACING PUMP - In replacing pump proceed as follows:

1. Pull guide tubes out about half way and rest cylinder on its side as shown in Figure "5".

2. Open air vent, inside upper end of small guide tube and place a receptacle to catch any oil that might escape at this point. Only one turn is required to open air vent. Do not turn further.

3. Enter the leather packings on end of stand pipe, into the brass lifting tube. In doing this care should be taken not to damage the leather packings.

4. While pushing the pump into position see that the pitman for pump enters the inside of pump plunger. Also place the end of lowering lever spring into recess in lug on pump casting. See Figure "5".

IMPORTANT - It is extremely important that there be clearance between the lowering lever adjusting rod and the lowering valve.

When replacing the pump, refer to Figure No. 6 and check this adjustment. The clearance space should be from $1/16"$ to $1/8"$. If adjustment is required, make certain the hexagon locking nut is securely tightened after adjustment.

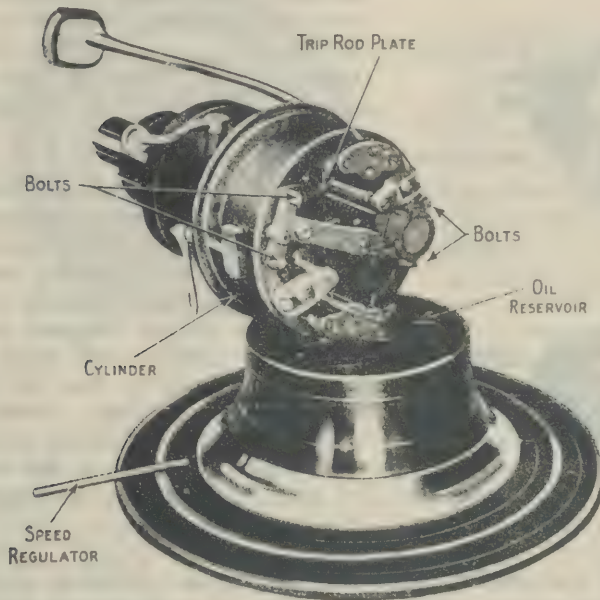


Figure 4

5. Push the pump into proper position and put in the four bolts holding same to cylinder. See Figure "4".

6. Fasten trip rod plate into position on lower end of large tube. This plate is held in place by one screw and a dowel pin. See Figure "4".

7. Screw the speed regulator into position. See Figure "3".

8. With the oil in the reservoir, place the cylinder in position, holding it as shown in Figure "8".

NOTE - When doing this see that rotary lock is in open position. The lever should be out and locking block down as shown in Figure "3".

9. With the air vent open, operate the main lever for about a minute to expel all air from the pump. After all air is expelled close the air vent, using a large screw driver to prevent leaking.

10. After fastening the chair top into proper position, the speed regulator can be turned in or out until the proper speed is obtained.

SPEED ADJUSTMENT - The speed of lowering may be regulated by turning Speed Regulator, No. 23, in the cylinder to the left for a more rapid descent, to the right for a slower descent.

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

ROTARY LOCKING LEVER - If Rotary Lever, No. 21, fails to lock to the satisfaction of the operator, remove the screw that holds the lever on locking stud, take off lever and replace one-quarter turn to the right to loosen or one-quarter to the left to tighten. Replace the screw, turning it securely into position.

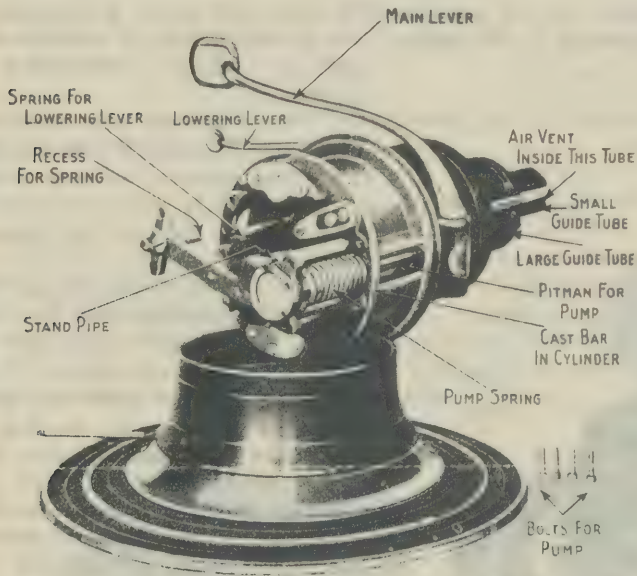


Figure 5

Lubricate the upper parts of the chair, such as Head-Rest, Tilting Device, Back Lock, Back Slides and all moving parts, with a few drops of oil, wiping off any surplus with a cloth.

GUIDE TUBES - After lengthy use, any wear on the guide tube bearing can be taken up by releasing Jamb Screws, No. 19, (Figure Two), on both sides of the cylinder and outer guide tube, then gradually tightening the adjusting screws, No. 20. Care should be taken when making these adjustments to turn each Adjusting Screw, No. 20, an equal amount and only a little at a time, until the required degree of rigidity is obtained. After adjustment is made the Jamb Screws, No. 19, must be turned down tightly.

THE BACK LOCK - The Back Lock, shown in Figure Eight, will require very little attention but should it fail to hold properly at any time the definite procedure outlined in this paragraph should be followed. Clean the back bar with a little gasoline or fresh oil; then tilt the back several times to work this up into the lock. The surplus should be wiped off and the lock thoroughly lubricated. If this does not cause it to hold properly, loosen the adjusting screw lock and tighten the adjusting screw until the proper tension is obtained. Then again tighten the lock screw.

LUBRICATION - Until the operation of the chair is understood, it is necessary to take every possible precaution in connection with its lubrication. It is much cheaper and more satisfactory in every way to use oil and a little time, than to be sending for new parts. Too much oil is better than not enough.

The oil supply for raising and lowering chair, automatically lubricates all working parts below the lifting lever. About every three months raise the chair to its highest position and remove the tube and cylinder covers, No. 28, and No. 31, (Figure Two). Give the guide rollers and chain pulleys thus exposed, each a few drops of oil. Follow arrows shown in Figure Seven.

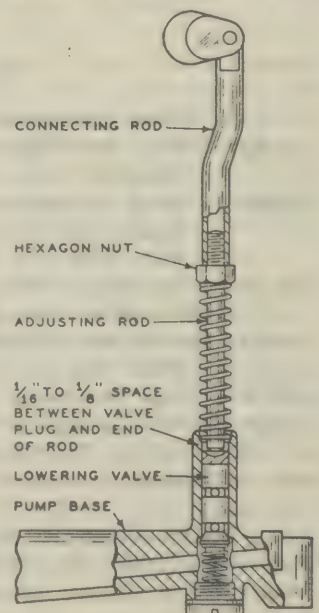


Figure 6

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

The locking for the clamp block and the stop pin for the back bar will probably never require attention but if for any reason adjustments of these parts must be made, all the necessary information can be secured from Figure Eight.

BACK - Back Lock Lever, No. 37, (Figure Two), controls the tilting of the back. To lower the back frame, hold the back with your left hand and press this lever. Releasing the lever automatically locks the back in any position. To raise the back, it is only necessary to lift it up without touching any lever.

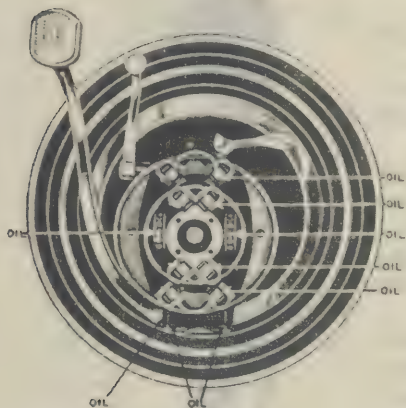


Figure 7

on surface of back pad.

3. Protect the leather upholstery and the floor from becoming oil spotted.

4. Place two or three drops of oil in upper and lower bearings (1). Move entire headrest back and forth from extreme forward position to backward position several times. (Note: This allows oil to circulate through bearings.)

5. Wipe off surplus oil.

6. Remove screw and lock washer (2) from lower end of supporting post, thus exposing the adjusting nut (3).

7. Turn adjusting nut (3) to right until one of the holes in the nut lines up with the next hole in the post into which the projection (4) on the lock washer (2) extends. Note: Throughout the adjustment be sure to have the locking lever of head-rest released.

8. Bring locking lever down to lock position and test headrest by pulling backward to determine if it holds in its bearings.

NOTE: If headrest does not hold, release locking lever and turn adjusting nut (3) to next hole right and again test.

9. When adjustment has been

HEAD-REST - The proper operating position for the Head-Rest is indicated by marks provided on the upper and lower Swivel joints on the Head-Rest. To place in proper position, merely loosen the locking lever and adjust the Head-Rest to the indicating marks, then tighten the locking lever. In this position it will only be necessary to raise or lower the Head-Rest to accommodate all patients except those of abnormal development.

PROCEDURE FOR ADJUSTING THE HEADREST WHICH DOES NOT HOLD FAST IN ITS UPPER AND LOWER BEARINGS - 1. (See Illustration No. 9A). Raise head-rest to highest position.

2. Release locking lever and position headrest yoke and pads forward so that they rest

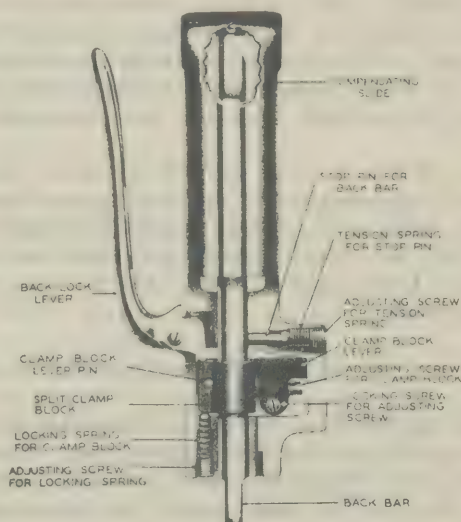


Figure 8

The locking for the clamp block and the stop pin for the back bar will probably never require attention but if for any reason adjustments of these parts must be made, all the necessary information can be secured from Figure Eight.

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

completed, replace screw and lock washer (2) to conceal adjusting nut.

BALL SOCKET TYPE HEADREST (OLD)

PROCEDURE FOR ADJUSTING A BALL AND SOCKET HEAD REST WHICH DOES NOT HOLD FAST IN ITS UPPER AND LOWER SOCKETS (See Illustration No. 11) - 1. Remove the adjusting screw (1) for upper ball socket.

2. Remove the adjusting screw (2) for lower ball socket.

3. Remove controlling screw (3) for lower half of headrest.

4. Disassemble and thoroughly clean all parts.

5. Lubricate with oil upper and lower ball sockets before reassembling.

6. Reassemble lower ball and socket and adjust with adjusting screw (2) being sure to leave cam lever (4) open.

7. Reassemble upper ball and socket and adjust with upper adjusting screw (1) being sure to leave cam lever (4) open.

8. Proper adjustment of upper and lower ball sockets will have been made when they hold fast after the cam lever (4) has been closed. When the adjustment has been tested as correct, then open cam lever (4) and adjust the screw (3) for controlling lower half of headrest so that lower ball and socket will be slightly tighter than the upper ball socket.

Note: The purpose of the controlling screw (3) on the headrest below the cam lever is to keep the headrest from completely collapsing while positioning it to patients.



Figure 9

HEAD-REST LOCK - The hinge pin for the locking lever should be oiled every six months, one drop applied each side of the lever being sufficient. The grooves in which the complete Head-Rest travels up and down should also be oiled regularly to prevent rust and insure smooth operation.

If, after a long period of use, the Head-Rest fails to hold properly, an adjustment is necessary. Referring to Figure Nine, remove the screw and lock washer from the lower end of the supporting post, thus exposing the adjusting nut; then tighten the nut until the desired tension is obtained. Be sure that one of the holes in the nut lines up with the hole in the post into which the projection on the lock washer extends.

Replace the lock washer and screw to maintain the adjustment.

ARM SUPPORTS - The arm supports are tested before leaving the factory and should require no further adjustment of any kind. If after lengthy use, the arm does not lock properly, open Locking Lever, No. 32, (Figure Two), turn Adjusting Nut, No. 33, to the right until satisfactory rigidity is obtained.

Use small spanner provided for the purpose.

FOOT-REST - Lever, No. 29, (Figure Two), operates the Foot-Rest. Push the lever forward to raise Foot-Rest and pull back to lower. This is particularly useful for anaesthesia. The mechanical parts of the Foot-Rest need very little

INSTRUCTIONS FOR THE RITTER FOOT-PUMP CHAIR

attention. If at any time in lowering, the Foot-Rest should collapse suddenly, it would be indicated that more oil is needed. To remedy this, remove upholstered

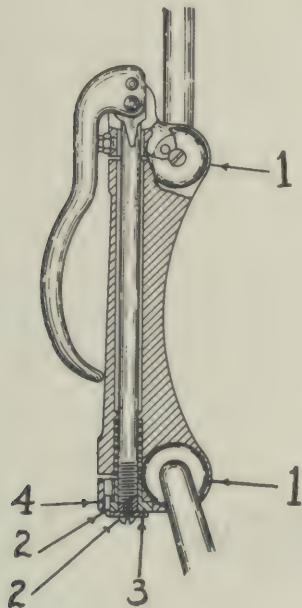


Figure 9A

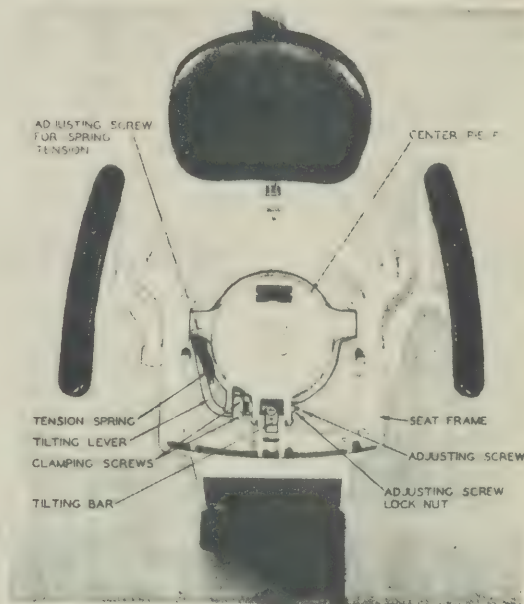


Figure 10

seat, take out Screw, No. 41, (Figure Ten), refill the plunger case with oil, and replace screw.

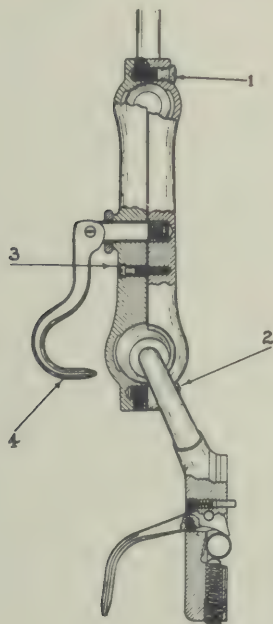


Figure 11

TILTING LOCK - In case Tilting Lock should not hold properly, remove the upholstered seat, clean the Tilting Bar with gasoline, apply a little lubricating oil to the tilting bar (Figure Ten) and tilt the top several times to work the oil into clamp, as the old oil may have become gummed, and caused the bar to slip.

If this does not overcome the difficulty, see that the two hexagon Clamping Screws for the tilting lever cap, (Figure Ten), are tight; then release the adjusting screw Lock Nut, press down on Tilting Lever and turn the Adjusting Screw in about one-quarter turn at a time, until lock holds properly when Tilting Lever is released. Do not make the mistake of turning the Adjusting Screw too far, as only a very slight adjustment is required. See that there is sufficient tension on the Spring for the Tilting Lever.

SECTION LXI

WEBER MODEL F CHAIR

WEBER MODEL "F" CHAIR OPERATION AND SERVICING

After removing the base section from shipping box, clear away all dirt or foreign substance from the base, especially the top. Also clean the oil can around the cap so that no dirt will enter the pump.

Remove the hexagon head screw, which is in the center of the cylinder at the top of base section. This is merely a cover. Use funnel and pour contents of oil can through this hole slowly so all of the oil will enter the pump through the small opening and not overflow, thereby losing oil.

After the oil is in the chair, release by several turns the vent screw, which can be seen through the hole from which the hexagon screw was removed. Then operate lever, which will force oil out at top, also any air which is in the pump. After pumping 15 or 20 strokes, the air should be expelled.

Next, tighten the vent screw firmly to prevent oil from emerging at that point. This can be done by turning the screw clockwise. The chair will then rise. If there is lost motion in the lifting lever, repeat the operation and continue pumping rapidly until all air is expelled.

NOTE - Allen wrench is furnished and fastened to under side of seat cushion.

ADJUSTING BACK FRAME LOCK - The vertical pivot block, which contains a round lock rod has a headless screw under the side, opposite the lever. Turn this screw to right or left as needed to secure proper adjustment. This adjusting screw is locked by a small set screw, which must be released before and locked after adjustment.

ADJUSTING TILTING LOCK LEVER - This lever holds entire upper structure in position when tilted to the desired angle. Adjustment can be made by turning nut at end of compression spring, which is accessible after removing the seat cushion. If necessary, the tilting lever can be reset to a new position by loosening the clamp bolt. After resetting to desired position, turn clamp bolt tight.

ADJUSTING ROLLER BEARINGS IN ELEVATING BASE - To adjust bearings, loosen four large slotted lock screws, under four Allen adjusting screws. Insert Allen wrench into adjusting screw and turn clockwise until tight, then adjust three remaining Allen screws until tight. Proceed the same on midsection, elevate chair about half way, then shake chair and check for play in telescoping sections. If still loose, adjust screws again until all play is removed, then tighten four slotted head lock screws. Be sure all rollers are bearing and chair does not bind when lowering.

TO ADJUST HEAD REST FORK LOCK - Release screw at the bottom of the head rest body. This, when released, permits the turning of the large screw at lower end one way or another until the proper locking adjustment is secured. After adjustment, tighten the lock screw to keep adjusting screw in a permanent position.

ADJUSTING ROTATING LOCK LEVER - This is adjusted by resetting the lever to the desired position. Loosen the Allen screw through lever, turn the lever to the desired position and again tighten the screw firmly.

TO REGULATE SPEED OF DESCENT ON FOOT PUMP CHAIR - Adjust a headless stop screw which is located at hinge of lowering lever. Turn this screw either way until desired speed limit is secured.

The regulating screw referred to is held in position by a second jam screw, which must be released while adjustment is being made and then tightened.

WEBER MODEL "F" CHAIR



THE WEBER MODEL "F" CHAIR

SECTION LXII

S. S. WHITE CHAIR

THE JOURNAL

OF THE AMERICAN MEDICAL ASSOCIATION

S. S. WHITE CHAIR

DIRECTIONS FOR UNPACKING AND SETTING UP S. S. WHITE DIAMOND CHAIRS NO. 2 AND NO. 3

After removing the top and front covers of the box which are attached with screws, the following procedure shall be followed in setting up.

Directions applicable to both S. S. White Diamond Chairs No. 2 and No. 3:

1. Remove the carton containing parts.
2. Remove the nuts and washers from the two long bolts through the wood frame.
3. Remove the Screws (4) holding frame to sides and lift out Frame.
4. Take out the can of Oil, Wrench and Funnel.
5. Tilt the box and remove the long bolt on open side of box, pushing it out through the bottom.
6. Lift Chair clear of the recess in the bottom and slide sideways out of the box.
7. Remove the strap holding the footboard to the end of the box and lift it out.
8. Clean all particles of packing material and dirt from the Chair.
9. Place Chair in its intended location.
10. Remove the small wood plug in top of Cylinder. This plug can be reached through opening in crosshead. Insert funnel and pour in can of Oil (8 pts.).
11. Replace plug.
12. Remove the twine holding foot-treadle and crosshead and Pump Chair to a convenient height for assembling various parts.

Directions applicable to S. S. White Diamond Chair No. 3:

13. Remove the Stop Screw in the center horn of the Seat Frame
14. Remove the Trunnion Screws which attach the Rocking Back in the Seat Frame.
15. Place a large piece of padding on the Seat Frame and rest the Rocking Back on it with the upholstered back down. Move the Rocking Back into position between the Trunnions of the Seat Frame, springing into place if necessary.
16. Replace the Trunnion Screws, tightening them up firmly with a large screw-driver and wrench.
17. Raise the Back from Seat Frame. Press the Rocking Back Lever (Fig. 3) forward toward the Rocking Back. With this lever held forward rotate the Rocking Back until the locking mechanism enters the channel in the center horn on the Seat Frame.
18. Release the rocking back lever and replace the stop screw in center horn.
19. Remove the head rest support stop screw and stop from the sliding back and slide the head rest combination into place.
20. The operating lever on the head rest support must be depressed to permit the combination to slide into position.
21. Replace the Stop and Stop Screw.

Directions applicable to S. S. White Diamond Chair No. 2:

22. Place Rocking Back on its standard position (align the two gold cross stripes on right trunnions). Attach complete Sliding Back Combination as shown in Figure 2, first backing out Stop Screw located beneath Swinging Back Pawl.
23. Tighten Stop Screw after back is in position.
24. Head Rest is assembled by sliding it down on Sliding Back (See Figure 2).

Directions applicable to both S. S. White Diamond Chairs No. 2 and No. 3:

25. Footboard is assembled as shown in Figure 3. Screw for attaching it is tied to the under side of the footboard.

S. S. WHITE CHAIR

26. To assemble Seat to Chair, pump Chair to its highest position; tilt Chair body to extreme position; put seat in place and fasten from below with (2) screws provided, screws going through holes in crosshead trunnion caps. Before tightening screws adjust Seat to position on Frame. See that it is far enough forward to clear movement of Rocking Back at its pivot.
27. Assembles Arms to Chair by sliding them down in recesses provided in the Seat Frame. The Chair should now be raised and lowered a number of times to free cylinder of air.

Directions for changing adjustment of the clamping handle on No. 9 head rest:

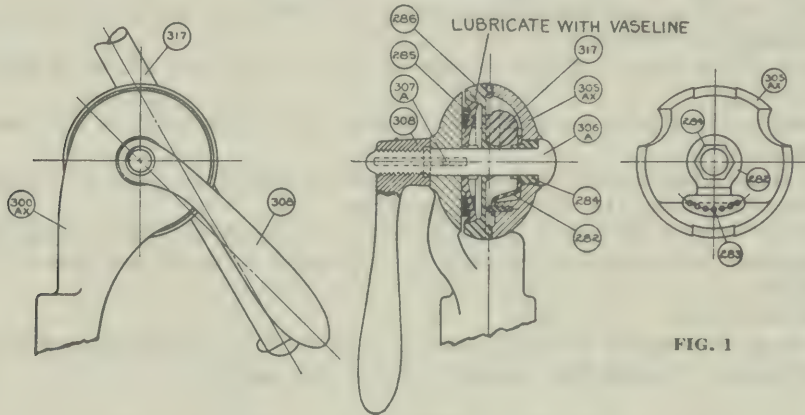


FIG. 1

Assembled construction of the clamping device is shown sectionally in Figure 1.

The recommended position for the Clamp Handle when tightened with moderate force (about 20 lbs.) is shown in Figure 1.

Should adjustment of Clamp Handle position be necessary, unscrew Clamp Handle (308) and remove Clamp Bolt (306A) and Clamp (305AX). Figure 1 illustrates the inside of this Clamp with Adjusting Plate (282) and Adjusting Screw (284).

To adjust the Clamp Handle clockwise (Fig. 1) shift Adjusting Plate (282) counter clockwise. One hold in Adjusting Plate (282) changes Handle 6° (about ½" at end of Clamp Handle). Shifting Adjusting Screw (284) one flat in Plate (282) changes Clamp Handle 36°. Reassemble as shown in Figure 1.

If Head Rest Clamp is completely disassembled, proceed as follows:

Screw Bolt Adjusting Screw (284) into Head Rest Clamp (305AX) as far as it will go, then back it out two-sixths of a turn.

Drop Adjusting Plate (282) over Bolt Adjusting Screw (284) and over Clamp Adjusting Pin (283), letting pin enter center hole in Plate (282).

Assemble the various parts to the Head Rest Support (300AX) in the arrangement shown in Figure 1, and tighten Clamp Handle (308).

The Taper Bearing surfaces where the Toggle (285) contacts with the Toggle Frame (286) should be lubricated with a film of vaseline.

S. S. WHITE CHAIR

If the Clamp Handle does not come to the proper position, adjust according to directions given in preceding paragraphs.

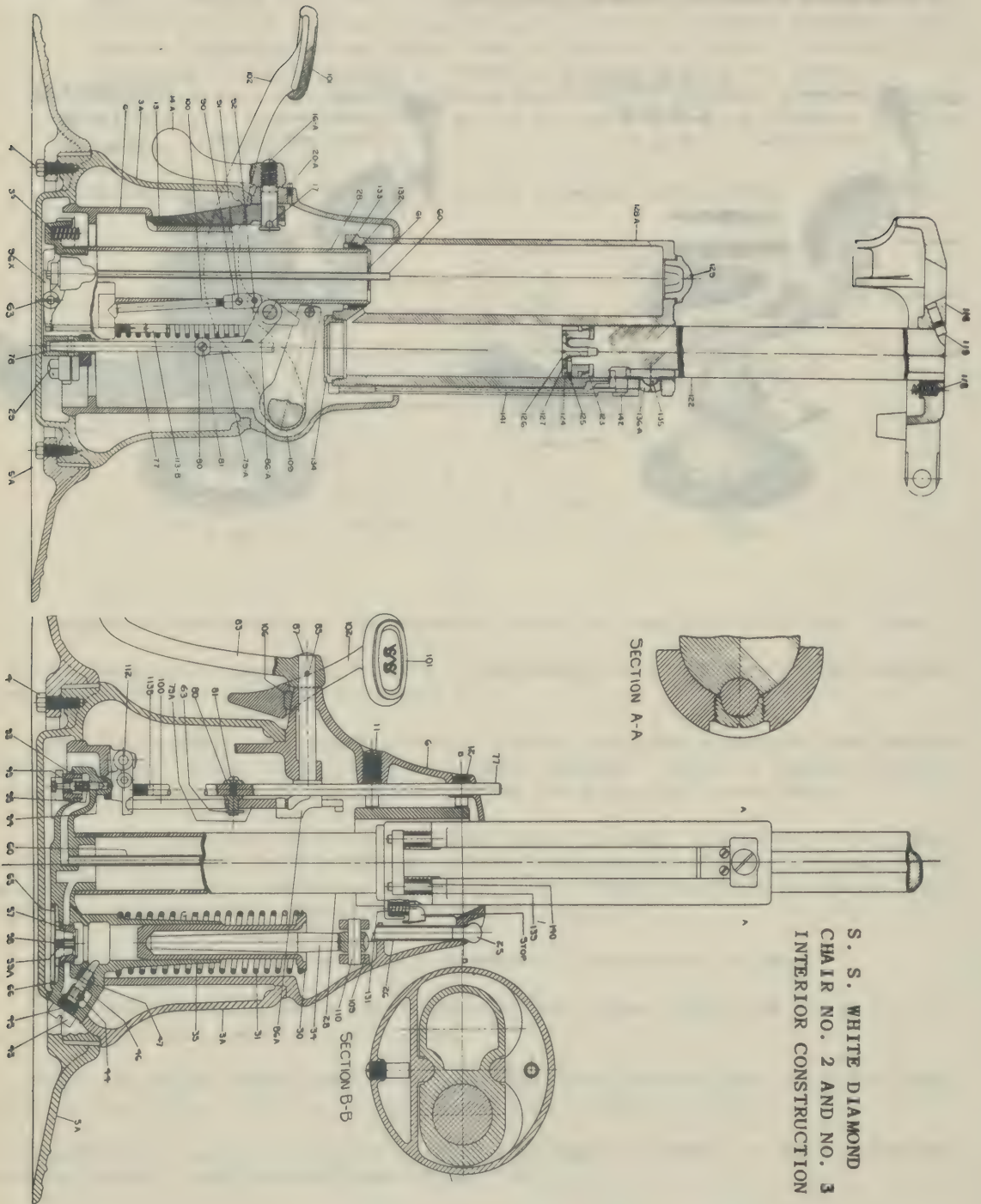


FIG. 2



FIG. 3

S. S. WHITE CHAIR



Parts List of Interior Construction of
S. S. White Diamond Chair No. 2 and No. 3

S. S. WHITE CHAIR

3A Base Body	59A Suction Valve Spring	106 Treadle Buffer
4 " " Screw (4)	60 Outlet Tube	109 " Arm
5A " Rim	61 " " Plate	110 " " Pin
6 Cylinder	63 Suction Valve Cotter	112 Trip Yoke Pivot
11 " Adjusting Screw (long)	65 Oil Strainer	113B " Adjusting Rod
12 " " (short)	66 " " Snap	122 Plunger
13 " Clamp	77 Trip Rod	123 " Packing
14A " " Lever	78 " " Bearing	124 " " Collar
16A " " Screw	79A " " Link	125 " " " Pin
17 " " " Pin	80 " " Stud	126 " " Screw
20A " " Lever Screw	81 " " " Screw	127 " " Washer
25 Oil Plug	82 " " " Cotter	128A " Slide
26 " " Tube	83 " Lever	129 " " Plug
28 Pump Frame Tube	85 " " Pin	131 " " Buffer
29 " " Screw (3)	86A " Crank	132 " " Packing
30 " Plunger	87 " " Shaft	133 " " Gland
31 " Spring	90 " Pitman Head	134 " " Bottom
33 " Frame Buffer	91 " " Screw	135 " Key
34 " Pitman	92 " " Pin	136A " " Screw
35 " Frame	93 " Valve Body	139 " Buffer (2)
43 Check Valve Body	94 " " Poppet	140 " " Pin (2)
44 " " Screw	95 " " Spring	141 " " Slide
45 " " Spring	96X " " Lever	142 " " " Cap
46 " " Poppet	99 " " Seat	176 Cross Head
47 " " Seat	100 Pitman Rod	178 " " Buffer
57 Suction Valve Body	101 Treadle Pad	179 " " Key
58 " " Poppet	102 "	

S. S. WHITE CHAIR

DIRECTIONS FOR REPLACING PLUNGER PACKING NO. 123 AND PLUNGER SLIDE PACKING NO. 132, CHAIR NOS. 1, 2, AND 3

TO REMOVE CYLINDER - Remove the Arms and Seat. In order to remove the seat on the No. 2 or No. 3 Diamond Chair, it will be necessary to take out the two knurl head screws underneath, holding it down.

Take out the two hexagon or square head screws (No. 200 Fig. 1) and remove Trunnion Caps. (These are right and left on the No. 2 or No. 3 Diamond Chair.)

Tilt the chair as far back as it will go and holding Rocking Lever (185) forward, lift Chair Body from the cross-head. (The cross-head is left on Plunger for convenience in handling.)

Unclamp lever 14A-Fig. 1 and lift the cylinder out of Base resting it on edge of Base as shown in Fig. 2, having Clamp Lever (14A) on top as shown.

Open trip valve slowly by means of trip lever 83XA-Fig. 2, after which unscrew and remove check valve combination, 43Y-Fig. 2. (Do not force or allow Plunger to move downward while this is being done.)

Roll Cylinder to the right until the elbow of Treadle is on top as shown in Fig. 3 and keeping trip valve open, work plungers in and out several times forcing both fully down and drawing all the way out each time. Pump Treadle No. 102-Fig. 3 a few times to expel oil from Pump.

Turn the Cylinder back to position shown in Fig. 2 and after making sure that Valve and Joint surfaces are perfectly clean, replace Check Valve Comb. 43Y setting it up tight.

With the Trip Lever in lowering position, force the Plungers all the way down and lift the Cylinder from the Base to a bench, or stand it up on the flat top of cross-head in a shallow pan on the floor.

TO REPLACE PLUNGER SLIDE PACKING NO. 132 - Take out the three hexagon or square head screws No. 29 Fig. 2 that secure the Pump Frame Combination to the Cylinder and remove it by pulling it out. (Care should be exercised in both removing and replacing Pump Frame Combination that the Brass Tube No. 28-Fig. 4 is not scratched or marred, otherwise the packing No. 132-Fig. 4 will be injured by it.)

Unscrew Plunger Gland No. 133-Fig. 4 and remove Plunger Slide Packing No. 132.

New Packings should be soaked in clean Chair Oil before placing in position.

To insert the Slide Packing, buckle it sideways, placing it into the recess in back of the thread.

Replace Plunger Slide Gland tightening it up firmly.

Let packing rest 10 to 15 minutes after first tightening and then give the gland nut a final tightening with wrench. Do not use a hammer and chisel.

Lubricate inside of packing and the outside of brass tube with clean Chair Oil, spreading it with the fingers. Enter tube into the packing, holding it central and parallel with the bore of the slide. When tube is part way in, examine to see that it clears the metal gland nut.

S. S. WHITE CHAIR

When replacing the pump frame attachment screws, have plunger slide all the way down to insure parts being centrally located, thereby preventing binding.

TO REPLACE PLUNGER PACKING NO. 123 - Remove the plunger slide bottom No. 134.

Lay the Cylinder on its side, loosen the cross-head clamp screw and remove the cross-head No. 176.

Push the plunger down until the top of the Plunger is even with the top of the Plunger slide No. 128A.

By means of a suitable screw driver remove plunger screw No. 126 after which the washer No. 127, Plunger Collar No. 124, and the Packing No. 123 can be removed.

Assemble new Packing to the Plunger, setting up Plunger Screw No. 126 with a monkey-wrench on a heavy screw-driver.

Replace plunger slide bottom No. 134 setting it up tight.

TO REASSEMBLE - Reassemble Cross-head to Plunger.

Return the Cylinder to Base, holding Clamp Lever up against its stop screw while doing it, otherwise Cylinder will not drop down into Base properly.

Pump Plungers up and reassemble Body.

Operate Chair throughout its entire range a few times to work out any air that may be in it.

S. S. WHITE CHAIR

Print "A"

Fig. 1

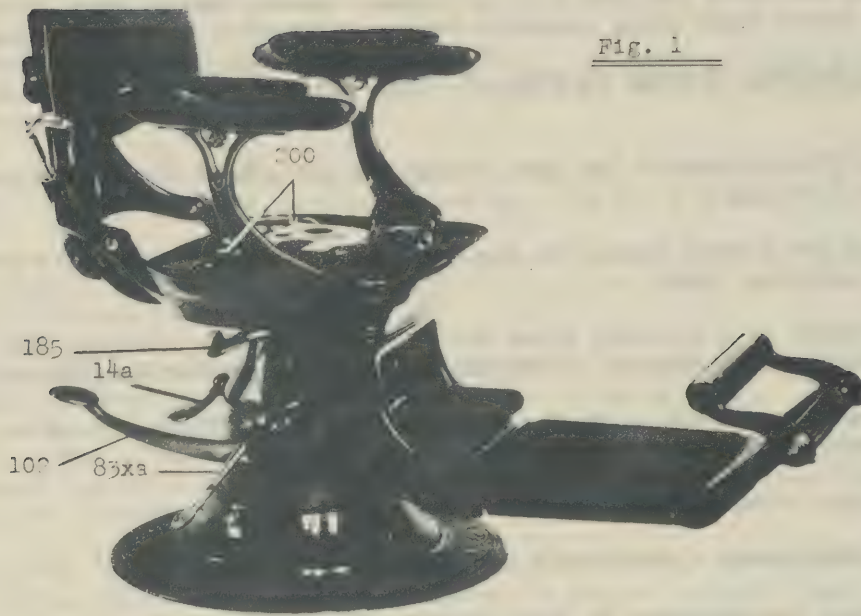


Fig. 2

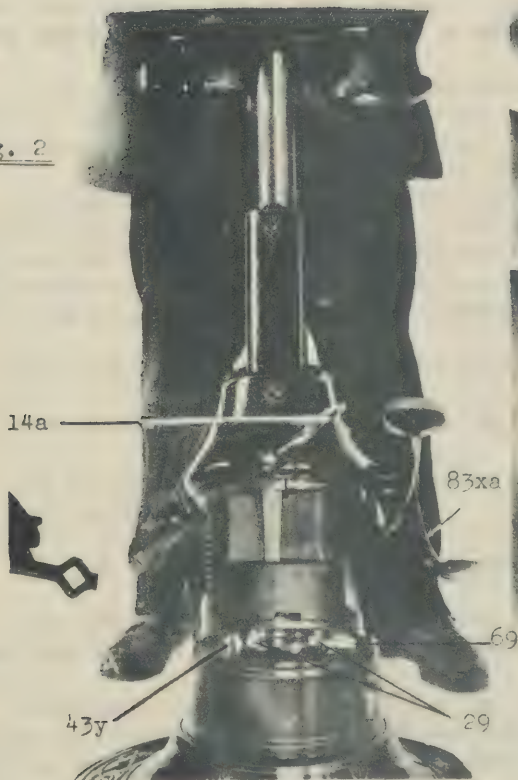
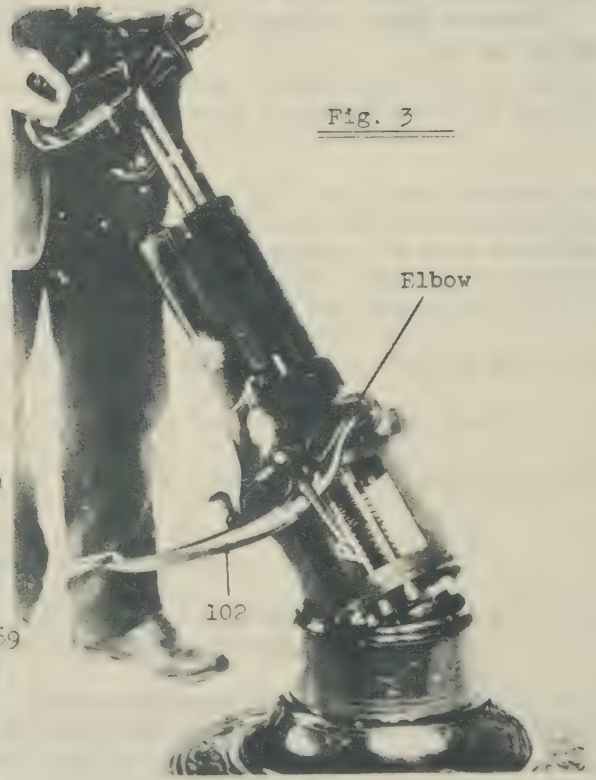


Fig. 3



No. 3401

S. S. WHITE CHAIR

DIRECTIONS FOR THE CORRECTION OF SETTLING BY CLEANING VALVES AND TIGHTENING PLUNGER PACKING NO. 123 AND PLUNGER SLIDE PACKING NO. 132, CHAIR NOS. 1, 2, AND 3

Before making any adjustments, pump the chair to its highest position and while standing up on the foot treadle so as to get the full weight of the body on it, have assistant throw the trip lever. This flushes the valves under a considerable pressure of oil and may dislodge any dirt that has become lodged on the valve seats.

If after several trials as above, the chair continues to settle, proceed as follows:

TO REMOVE CYLINDER - Remove the Arms and Seat. In order to remove the Seat on the No. 2 or No. 3 Diamond Chair, it will be necessary to take out the two knurl head screws underneath, holding it down.

Take out the two hexagon or square head screws (No. 200 Fig. 1) and remove Trunnion Caps. (These are right and left on the No. 2 or No. 3 Diamond Chair.)

Tilt the chair as far back as it will go and holding Rocking Lever (185) forward lift Chair Body from the cross-head. (The cross-head is left on Plunger for convenience in handling.)

Unclamp lever 14A-Fig. 1 and lift the cylinder out of Base resting it on edge of Base as shown in Fig. 2, having Clamp Lever (14A) on top as shown.

Open trip valve slowly by means of trip lever 83XA-Fig. 2 after which unscrew and remove check valve combination, 43Y-Fig. 2. (Do not force or allow Plungers to move downward while this is being done.)

Roll Cylinder to the right until the elbow of Treadle is on top as shown in Fig. 3 and keeping the trip valve open, work plungers in and out several times forcing both fully down and drawing all the way out each time. Pump Treadle No. 102-Fig. 3 a few times to expel oil from Pump.

Turn the Cylinder back to position shown in Fig. 2, and after making sure that Valve and Joint surfaces are perfectly clean, replace Check Valve Comb. 43Y, setting it up tight.

With the Trip Lever in lowering position, force the Plungers all the way down and lift the Cylinder from the Base to a bench, or stand it up on the flat top of cross-head in a shallow pan on the floor.

TO TAKE OUT TRIP VALVE ON NO. 2 OR NO. 3 DIAMOND CHAIR - With Cylinder in this position, remove Trip Valve Lever No. 96-Fig. 4 by taking out cotter No. 98, remove Valve by unscrewing Body No. 93 and examine Valve and Valve Seat. After making sure surfaces are perfectly clean, replace the parts as originally found. Be sure in reassembling that Valve Body No. 93 is set up tight.

TO TAKE OUT TRIP VALVE ON NO. 1 DIAMOND CHAIR - Remove the Trip Valve 69-Fig. 2 with a screw driver. After cleaning the Valve and Seat, replace Valve setting it up tight.

TO TIGHTEN PACKINGS ON NOS. 1, 2 AND 3 DIAMOND CHAIRS - Take out the three hexagon or square head screws No. 29-Fig. 2 that secure the Pump Frame Combination to the Cylinder and remove by pulling it out. (Care should be exercised in both

S. S. WHITE CHAIR

removing and replacing Pump Frame Combination that the Brass tube No. 28-Fig. 4 is not scratched or marred, otherwise the packing No. 132-Fig. 4 will be injured by it.)

Plunger Slide Packing No. 132-Fig. 4 can now be tightened up by screwing down Plunger Slide Gland No. 133-Fig. 4.

Remove Plunger Slide Bottom No. 134-Fig. 4 and tighten the Plunger Screw No. 126-Fig. 4. This tightens Plunger Packing No. 123-Fig. 4.

Replace Plunger Slide Bottom No. 134, setting it up tight.

Replace Pump Frame Combination taking care tube is not marred as mentioned previously.

TO REASSEMBLE - Return Cylinder to Base, holding Clamp Lever up against its stop screw while doing it, otherwise Cylinder will not drop down into Base properly.

Pump Plungers up and reassemble Body.

Operate Chair throughout its entire range a few times to work out any air that may be in it.

A wrench is provided with each Chair sent out to make most of the above adjustments. For the removal of the Trip Valve Body on the No. 2 or No. 3 Diamond Chair a 9/16" open end wrench or a small monkey wrench will be needed. For the tightening of the Plunger Screw No. 126 and Trip Valve No. 69, suitable screw drivers will be needed.

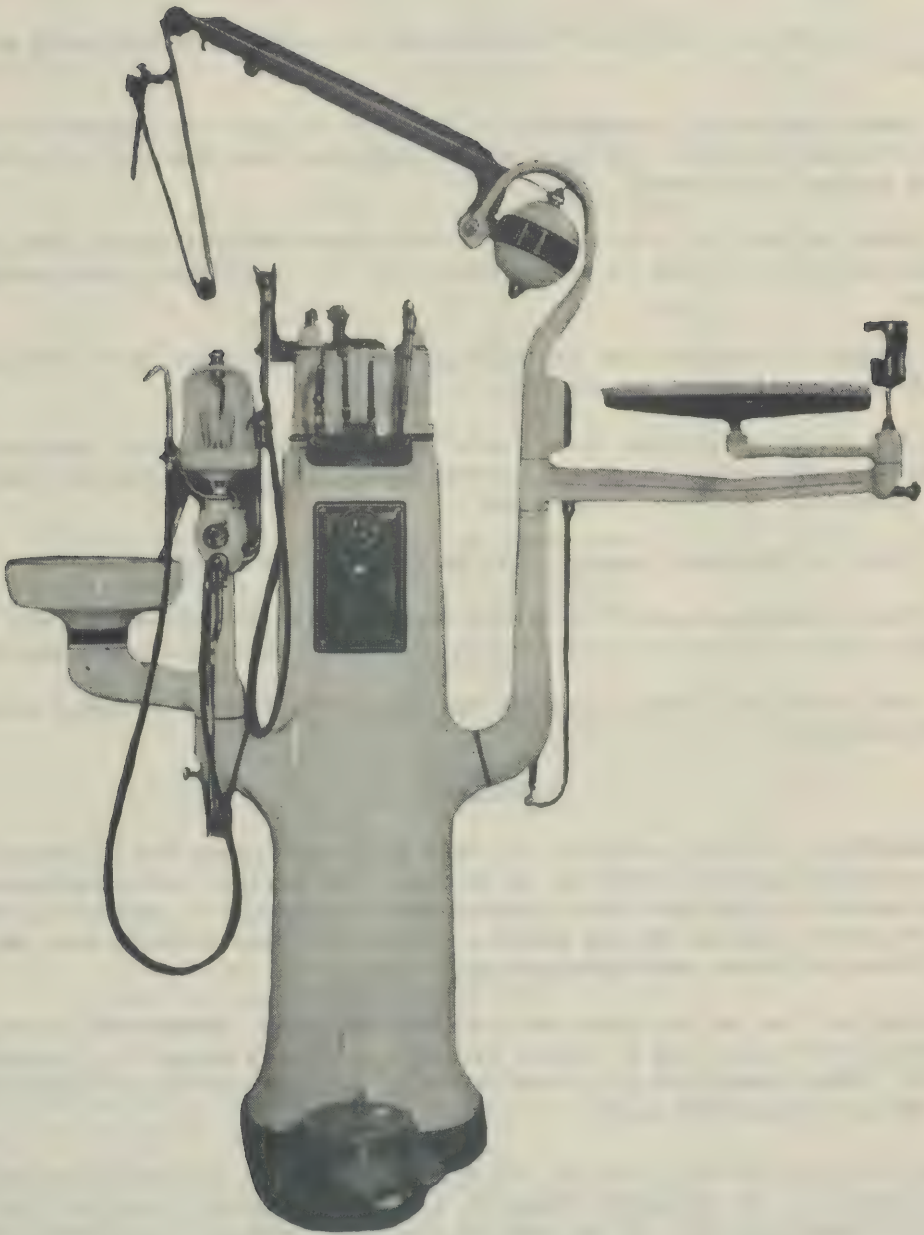
SECTION LXIII

RITTER MODEL E UNIT EQUIPMENT

NOTES

1950-1951

RITTER UNIT EQUIPMENT - MODEL "E"



RITTER UNIT EQUIPMENT
MODEL "E"

RITTER UNIT EQUIPMENT - MODEL "E"
INSTALLATION, OPERATION AND MAINTENANCE
IMPORTANT

1. Carefully read the printed instructions before mounting and operating the Ritter Unit Equipment.
2. In unpacking be sure the tools used do not strike the equipment and injure the finish.
3. Before making any connections to the Unit, be sure the current is suitable. Refer to the name plate on the back of the pedestal near the top for information regarding current to be used.
4. When the Unit is to be operated from a direct current supply line, a Rotary Converter must be employed in connection with it. See directions under Rotary Converter.
5. Be sure to blow out the air piping from the Compressor, with full air pressure, before connecting it to the Unit.
6. All joints in the gas line should be carefully tested for leaks before the cover plate is replaced on the Unit. Serious damage may result if a gas leak exists. See paragraph "Testing Connections".
7. Shut off the water supply valve on the pedestal every night.
8. The low voltage switch on Direct Current Units should be shut off when the instruments are not in use to avoid running the rotary converter unnecessarily.
9. The finish will stay just like new for years if it is properly cleaned and polished regularly.

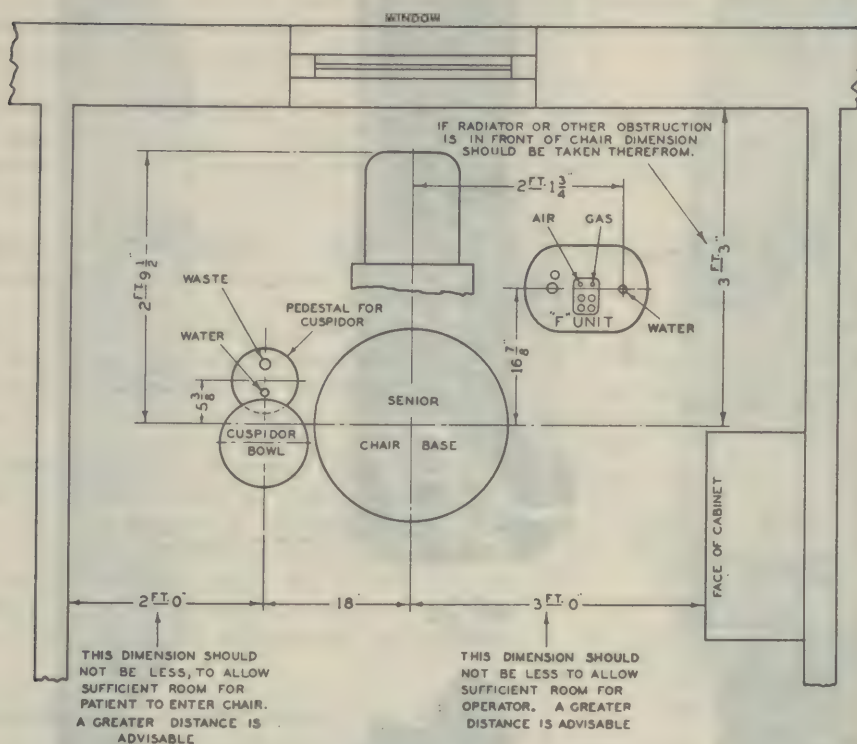
INSTALLATION

UNPACKING - The Unit pedestal is held in the shipping box by means of five bolts, two on the back and three on the bottom. The various unattached accessories are also packed in the same box. Unnecessary roughness in unpacking should be avoided to prevent damage to the finish. Be careful not to throw away any of the smaller pieces with the packing material.

Lay the box flat on the floor and take off the cover. Remove the engine, glassware, bracket table arms and all other packages and boxes packed in the compartment in the top. Then remove the nuts from the three bolts which fasten the Unit to the bottom. *Do not remove the bolts.*

Stand the box upright, take out the screws and remove the two blocks which hold the wood brace for the swinging cuspidor arm. Next remove the nuts from the two bolts which fasten the Unit to the back of the box. Take out all five bolts, then carefully remove the Unit. The brace for the swinging arm will slide out when the pedestal is removed. Lastly remove the sub-base and engine arm from the box and remove the wood brace from the back of the Unit.

RITTER UNIT EQUIPMENT - MODEL "E"



FLOOR PLAN

SHOWING LOCATION OF CHAIR, MODEL "F" UNIT
AND PEDESTAL CUSPIDOR

USE THIS PLAN FOR PROPERLY
LOCATING UNIT IN THE ROOM

FIGURE NO. 1

NOTE: - When placing the chair and Unit in front of a window, the dimensions shown in the cut are the minimum distances allowed. Where the space permits, an increased distance of five or six inches is advisable.

LOCATING UNIT - When all this has been done, the Unit is in condition to be located and connected in proper relation to the chair. Figure No. 1 illustrates floor plan for the Model "E" Unit.

PIPING AND CONDUITS - There are various ways in which the water, air, gas, and electrical connections may be made to the Unit, depending on building construction and plumbing requirements. A complete installation plan accompanies each Unit explaining the procedure to be followed when installing the equipment.

When concealed plumbing is being installed, the space in the floor around the pipes must be filled in to prevent moisture from entering the Unit and causing rust.

SUB-BASE - The porcelain enameled sub-base adds a finishing touch to the base of the Unit and protects it from the effects of water and floor cleaning solutions.

RITTER UNIT EQUIPMENT - MODEL "E"

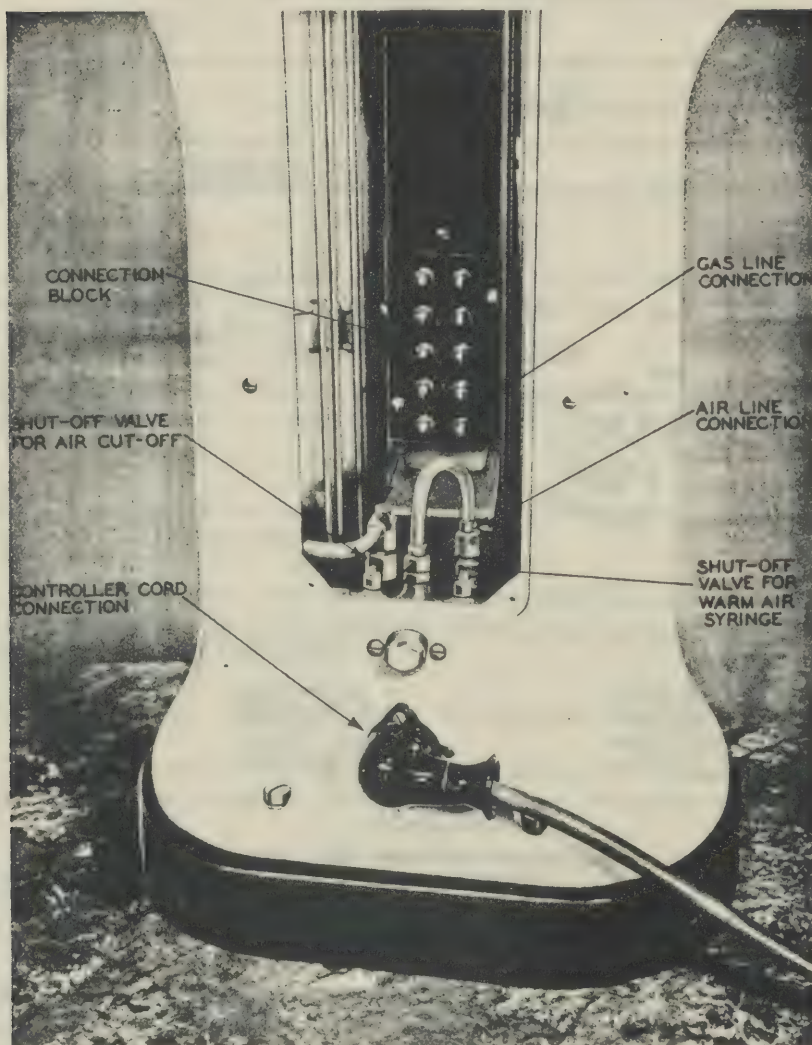


FIGURE NO. 1A

The sub-base should be completely installed first, fastening it to the floor securely with four screws.

If the floor is of wood construction and in poor condition, it is obvious that the Unit cannot be installed in a stable manner; therefore, before installing the sub-base, it is essential that the floor be made firm and rigid.

CONNECTING UNIT - Place the Unit on the sub-base and fasten securely with the three screws. The services of post engineer should be procured to connect the gas, air, water, and waste lines, and all the electric supply connections.

In order to make the waste and water connections in the Unit, it is necessary to temporarily remove the two counterweight pulley guide rods nearest the back on the side where the connection is to be made. The rods may be taken out by removing

RITTER UNIT EQUIPMENT - MODEL "E"

the nut from the upper end of each of the two rods, dropping the rods down, tilting them to one side and withdrawing. When reassembling the rods, be sure to pass them through the counterweight bushings.

WASTE WATER CONNECTIONS - Not provided on the Unit itself, is a trap in the cuspidor waste water pipe. Therefore it is necessary in arranging the plumbing, to make provision for a one inch trap which will meet the requirements of the local plumbing inspector.

WATER SUPPLY CONNECTIONS - The water supply line should be connected to the Unit by means of a 3/8 inch pipe.

NOTE - Should the water pressure exceed 45 or 50 lbs., the installation of suitable pressure-reducing valves is recommended. These valves may be installed at any suitable point in the water line before it reaches the Unit. The plumber making the Unit installation should supply the necessary parts.

GAS CONNECTIONS - The gas connection is located in the lower part of the Unit and may be identified by means of a tag attached. See Figure No. 1A. It should be connected to the gas main by a 1/4 inch pipe as shown in the illustrations. Make certain that all gas joints are tight as leaks may result in serious damage.

COMPRESSED AIR CONNECTIONS - The piping from the air compressor must be connected to the air regulator located in the base of the Unit pedestal. Refer to Figure No. 1A. Great care should be taken to see that this is properly connected, for interchanging the air and gas connections would cause serious trouble. Use copper tubing for making the connections. The piping from the compressor should be blown out with full air pressure before it is connected to the Unit.

Most of the trouble with compressed air piping is due to poorly designed air fittings, which do not make absolutely air tight joints. The use of air fittings, constructed with a metal to metal cone seat which makes a permanent air tight connection unaffected by any atmospheric changes is advised.

TESTING CONNECTIONS - Before replacing the cover plate on the Unit, test the gas, air, waste and water pipe connections for leaks. The gas and air connections can be easily tested by putting a little oil on them. Bubbles will quickly appear if a leak exists. This work should be done carefully, as the presence of leaks might prove serious.

SUPPLY WIRE CONNECTIONS - After all the water, gas and air connections are completed, the electrical connections should be made to the connection block as indicated by directions on the block and shown in Figure 2.

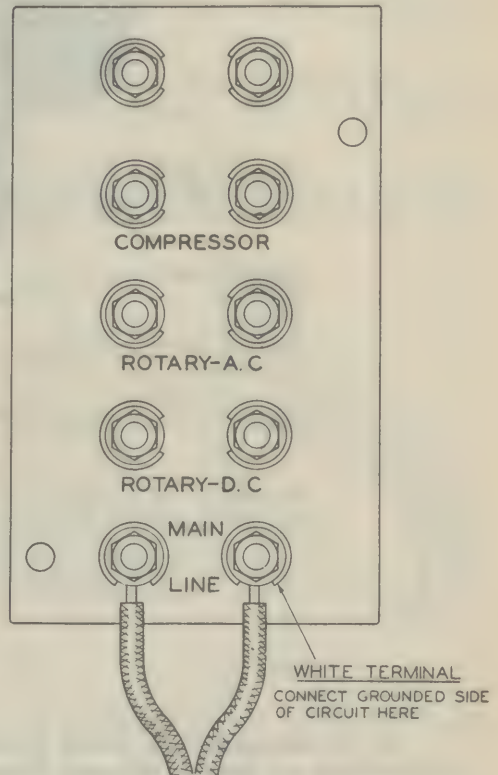


FIGURE NO. 2

RITTER UNIT EQUIPMENT - MODEL "E"

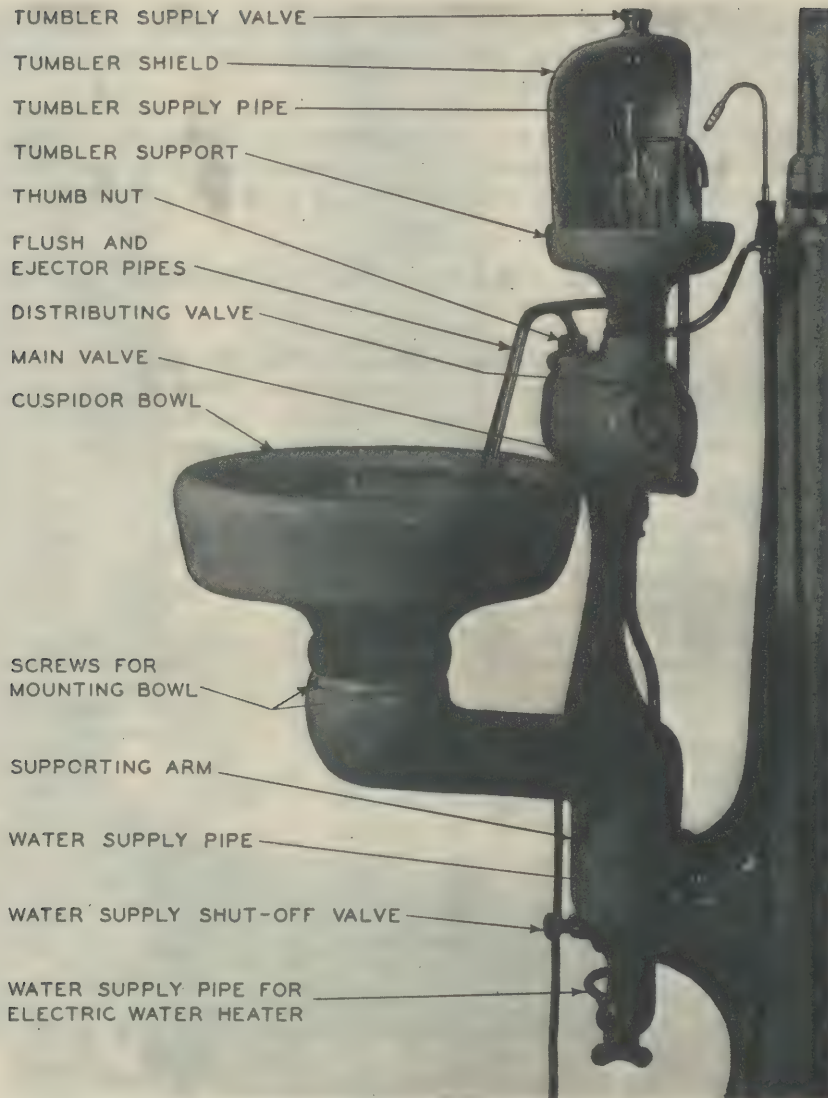


FIGURE NO. 3

It is necessary to place 15 ampere fuses in the main supply circuit for either alternating or direct current Units, for no provision is made in the Unit equipment for fuses.

The name plate on the back of the pedestal near the top indicates the kind of current for which the Unit is intended. Make sure your current is the same, then proceed to make the necessary connections, using No. 14 rubber covered wires.

CONDUIT WIRING - If the Unit is to be operated on alternating current two 1/2 inch conduits are necessary.

If the Unit is to be operated on direct current three 1/2 inch conduits are necessary.

RITTER UNIT EQUIPMENT - MODEL "E"

The use of flexible conduit makes it easier to install the Unit, as conduit center distances do not need to be maintained so accurately.

ROTARY CONVERTER - When the Unit is to be operated on a direct current supply, it is necessary to use a Rotary Converter in connection with it; this changes the direct current to alternating current required for the low voltage instruments. It may be located in any convenient place and connected to the four binding posts on the connection block, (See Figure No. 2), in the lower part of the Unit pedestal by means of four No. 14 rubber covered wires or two No. 14 twin wires, if wiring is all in conduits. Follow the directions on the Rotary Converter name plate.

The Rotary Converter should be oiled at least once a month.

IMPORTANT - To save the current used by the Rotary Converter and also to save wear on it, stop it whenever the low voltage instruments are not to be used for any length of time. The Rotary Converter is used only with Units operated from a direct current supply line. The current leading to the Rotary Converter is controlled by means of a switch on the right hand side of the control panel marked, "Switch for low voltage instruments", in Figure No. 12.

When the Unit is operated from an alternating current supply line, this same switch controls the current to the transformer. The current used by it when no instruments are in use, is only about four watts.

CUSPIDOR (Model C) - Three screws are provided in the swinging cuspidor arm for mounting the large cuspidor bowl. Back these screws out a few turns, mount the bowl on the arm, being sure the gasket washer is in place and the bowl is properly placed over the dowel pin provided. Tighten the screws securely.

The tumbler supply valve, located at the top of the tumbler supply pipe, must be partially disassembled before the shield can be attached. Refer to Figure No. 4 and proceed as follows:

1. Remove screw (A).
2. Unscrew and remove knurled handle (B).
3. Unscrew and remove nut (C).
4. Remove ferrule (D) and rubber washer (E).

5. Assemble glass shield (F) and above parts as illustrated, being sure that rubber washer (G) is underneath glass shield.

Before tightening the clamping nut (C) make sure that the glass shield (F) will not be forced down onto the glass tumbler support so tightly as to cause possible damage. The lower end of the tumbler supply pipe is threaded and, before leaving the factory, is screwed into the valve body the proper distance to provide adequate space for the glass shield. However, if readjustment of the pipe is necessary, loosen the coupling nut, screw the pipe in or out as required, and again tighten the coupling nut to prevent leakage. Insert the strainer assembly in the waste opening in the glass support.

Slip the flush and ejector pipes into the two knurled thumb nuts on the top of

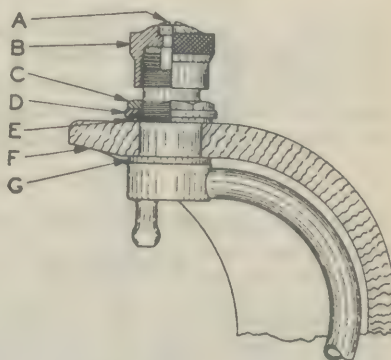


FIGURE NO. 4

RITTER UNIT EQUIPMENT - MODEL "E"

the valve body. Allow about 1/8 inch clearance between the end of the nozzles and the bottom of the bowl, then tighten both thumb nuts with the fingers.

Insert the gold trap and funnel in the opening in the center of the cuspidor bowl.

Pass the saliva ejector tubing through the support and connect the union nut to the valve body, as illustrated. Be sure the nut is drawn up tightly with a wrench.

The cuspidor supporting arm on the Model "E" Unit is provided with two holes for the cuspidor swinging arm stop screw. When shipped from the factory the stop screw is located in the hole to the left, as one faces the rear of the Unit, and a plug screw is provided in the hole to the right. This arrangement allows the cuspidor to swing forward only to the center line of the Unit, and is intended for use when the Unit is to be mounted parallel with the chair. If the Unit is installed at an angle to the chair, which is recommended, and which is shown in Figure No. 1, it is necessary that the stop screw and plug screw be reversed so that the stop screw is located in the hole to the right, thus allowing the cuspidor to swing forward to bring it into correct relationship to the chair.

The water supply pipe for the cuspidor should be positioned toward the front of the Unit as shown in Figure No. 3. This adds to the general appearance of the equipment and also facilitates the assembly of the electric water heater supply pipe. Loosen the union nut underneath the supporting arm to change the position of the pipe.

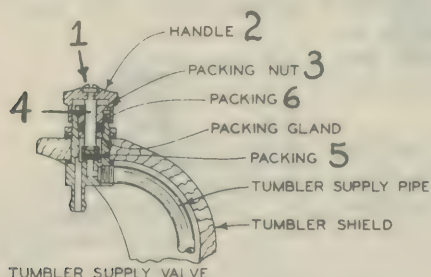


FIGURE NO. 5

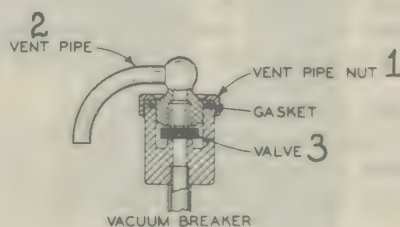


FIGURE NO. 6

Adjustment is to be made when there is a constant dripping of water from the tumbler water supply spigot indicating that the valve packing is worn and needs replacement. (See Figure 5.)

Procedure:

- 1st - Shut off main cuspidor supply valve so that no water flows through cuspidor.
- 2nd - Open tumbler supply valve so as to drain off remaining water.
- 3rd - Remove screw (1) from valve handle (2) and remove valve handle.
- 4th - Unscrew and remove packing nut (3) and pull out valve stem (4).
- 5th - On end of valve stem is a countersunk packing (5). Remove it with a pointed instrument and insert new packing, pressing firmly into place with the thumb.
- 6th - On the valve stem there is also a graphite packing (6) which seldom needs replacing.
- 7th - Reassemble the tumbler supply valve and test.

NOTE - If the valve stem (4) is badly corroded, replace it with an entire new valve stem assembly.

RITTER UNIT EQUIPMENT - MODEL "E"

Adjustment is to be made when water drips out of vacuum-breaker spigot, indicating the vacuum breaker valve is worn and needs replacing. (See Figure 6.)

Procedure:

- 1st - Shut off main cuspidor supply valve so that no water flows through cuspidor.
- 2nd - Open tumbler supply valve so as to drain off remaining water.
- 3rd - Unscrew with the hand the vent pipe nut (1) and remove it and the vent pipe (2).
- 4th - Lift valve (3) out of vacuum breaker body and replace with new valve.
- 5th - Reassemble and test.

The swinging cuspidor arm should be lubricated with a few drops of oil where the swinging arm fits into the Unit casting. This lubrication should be done every six months.

ELECTRIC WATER HEATER - Refer to Figure 13 and assemble the reservoir in heater, being sure that the two pins, shown in Figure No. 19, which hold the reservoir in the cup, do not protrude and that the thermostat terminals engage the clips on the connection block. Force the reservoir down into the cup, then secure in place by means of the screw located in the center of the circular name plate.

Assemble the water supply pipe, first inserting the pipe in the slip joint union on the heater; then, after making certain that the packing washer is in place, tighten the union nut on the other end. The pipe connects to the cleanout plug housing on the cuspidor supply pipe.

Refer to Figure No. 19 and attach the regulator and insulating joint, for the Thermo-water syringe, to the outlet on the heater as illustrated. Wrench No. 2, which is supplied with the cuspidor, may be used for tightening the union nut securely. The metal tube, which contains the wires entering the pedestal, must not be unduly cramped, when tightening the union nut, or the moulded cover for the insulating joint terminals may be broken.

MOUNTING BRACKET TABLE ARMS AND ENGINE - Reference to the illustrations will plainly show how these parts are to be mounted. The bracket table arm must be placed upon the supporting arm first, after which the engine may be placed in position. It is a good plan to coat the collector rod support with a thin film of vaseline. This eliminates friction and undue wear of the spring contacts. When placing the engine supporting yoke over the collector rod, make certain to hold the engine yoke exactly vertical, so the spring contacts inside the yoke will not be bent. The engine should never be placed upon, or removed from, the collector rod support while the main line switch is "on". The small bracket table arm is next assembled to the large arm. A drop of oil should be placed on the joint when assembling.

IMPORTANT - To insure proper functioning of the radio interference eliminator, incorporated in the engine, it is necessary that this equipment be satisfactorily grounded, if not equipped with a water line, by means of the electrical conduit or a ground wire run from the pedestal to a water pipe.

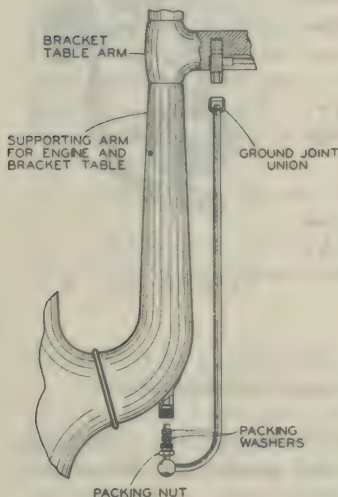


FIGURE NO. 7

RITTER UNIT EQUIPMENT - MODEL "E"

To make sure that a satisfactory ground is effected, connect one wire of a test lamp to the live side - indicated by brass terminal on connection block - of current supply line and the other wire to one of the screws which hold the cover plate to the engine yoke support. A bright light will indicate a good ground connection.

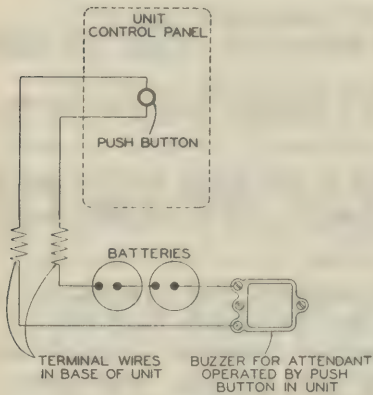


FIGURE NO. 8

BELL WIRING - The bell wires are located in base of the pedestal to the left of the air regulator and may be run to a bell or buzzer or door opener, as the case may be, making the battery connections as shown in the wiring diagram, Figure No. 8. If desired, a bell transformer may be used instead of batteries. The wires may be run in conduit or under staples, whichever is most convenient.

ENGINE ARM ASSEMBLY - Remove the thumb screw, then mount the engine arm as shown in Figure No. 9. Replace the thumb screw and tighten it well with a screwdriver. Do not depend upon the fingers alone. This is important. The motor balances the engine arm and handpiece and is properly adjusted before leaving the factory. No other adjusting should be necessary, but if it is required, turn the large thumb nut, which binds the motor between the two yoke tubes, to the right to increase or to the left to lessen the friction.

ATTACHING HANDPIECE - In order to obtain the best results from the engine, the handpiece must be attached to the engine forearm so it cannot turn around.

If the S.S. White Handpiece, or K4 Attachment is used, the latch spring #64 will need to be replaced by SSW part #200, or the handpiece will turn on the end of the forearm and quickly wear out the belt.

If other makes of handpieces or wrist joints are used, the makers will furnish the proper springs when advised as to the engine for which they are wanted.

BELT ATTACHMENT - The belt guard on the motor pulley is made to lift back out of the way so that the belt can be easily placed around the grooves. The small groove is for slow speeds, the large groove for high speeds.

Having passed the belt around one of the grooves in the pulley, push the guard back into place, making sure that it has not pinched the belt.



FIGURE NO. 9

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Now lift the belt guards, as shown in Figure No. 10. Pass the belt along each side of the engine arm around the remaining pulleys and down to the handpiece. Hold the handpiece in the hand so the two small guide pulleys hang downward; put the belt around the handpiece pulley, then over the two small guide pulleys. If the belt is too short or too long, adjust the length by turning the thumb screw shown in Figure No. 11.

Snap the belt guard back into place so the belt cannot come off.

BELT TENSION ADJUSTMENTS - The belt-adjuster on the engine arm enables the operator to obtain any belt tension desired, quickly and easily by simply turning the thumb screw as shown in Figure No. 11; one way tightening the belt, the other way loosening it.



FIGURE NO. 10

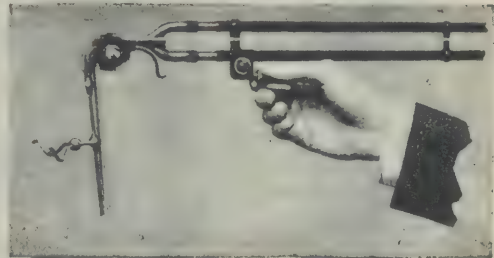


FIGURE NO. 11

It is quite important, however, to run the belt as loosely as possible, otherwise when the belt twists around the handpiece, it will be so tight that it will interfere with free use.

Always bear in mind that the motor drive pulley is so constructed that it is an advantage to run a loose belt.

MOUNTING LIGHTS - To assemble the supporting tube for the light, first engage the plug of the cord end with the receptacle in the adapter on the Unit. Then slide the tube down over the adapter; at the same time drawing the slack out of the wire through the upper end of the tube. Coil the portion of the wires which project from the upper end of the tube, this being necessary to insure space in the tube for the wire when the bracket is inserted into the post.

CAUTION - Do not connect a sterilizer or X-Ray machine to the Unit.

READY FOR USE - If all the directions have been observed, as herein outlined, the Unit should now be in perfect condition for operation.

OPERATION

MASTER SWITCH - Looking at the front face of the pedestal, the switch located on the left hand side of the control panel is designated as the main line or master switch. When this switch is in the "on" position, the current is on all the electrical appliances connected with the Unit with the exception of the low voltage instruments. The pilot light indicates when the main line switch is "on" or "off". See Figure No. 12.

SWITCH FOR LOW VOLTAGE INSTRUMENTS - This switch is on the right hand side of the control panel and controls the current to the transformer or Rotary Converter.

RITTER UNIT EQUIPMENT - MODEL "E"

All low voltage instruments, such as the pulp tester, warm air syringe, cautery, mouth lamp, etc., are controlled by this switch which may be shut off without interfering with the use of the engine, spray bottle heater or other full voltage appliances connected to the Unit.

IMPORTANT - If the Unit is operated from direct current, shut off this switch when the low voltage instruments are not to be used for any length of time to save running the rotary converter unnecessarily. See Rotary Converter directions, Page 7.

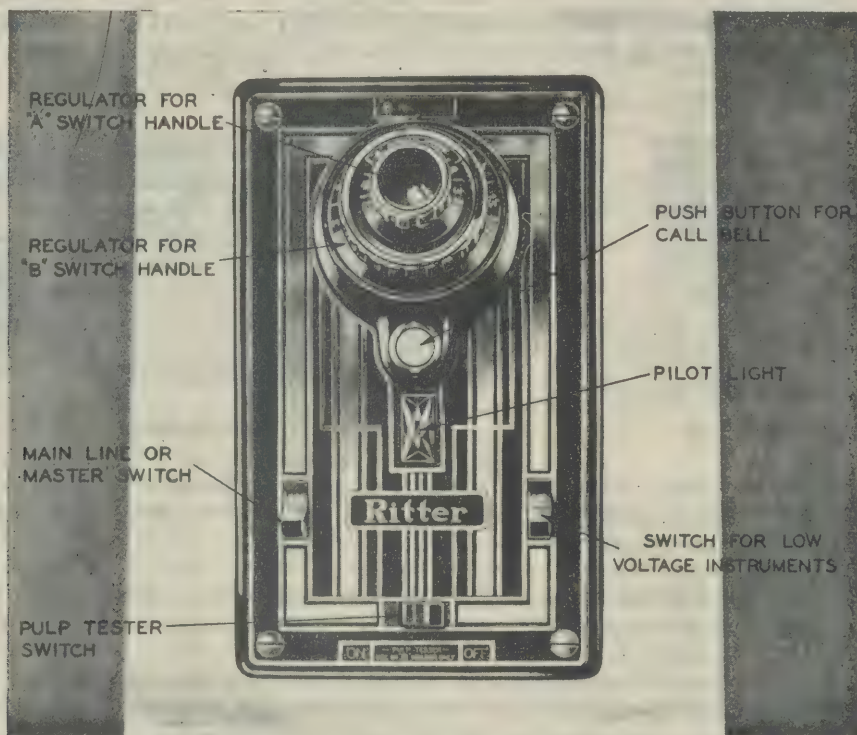


FIGURE NO. 12

PULP TESTER SWITCH - The "Pulp Tester" switch, located at the bottom of the control panel, directs the current to the "B" switch handle. The switch must be placed in the position indicated, when using the pulp tester, cautery or other low voltage heating instruments.

CAUTION - The above instructions must be observed, otherwise satisfactory results cannot be obtained.

REGULATORS FOR LAMPS AND LOW VOLTAGE INSTRUMENTS - The regulators, which control the current to the switch handles, are shown in Figure No. 12. The small "A" regulator controls the current to the "A" switch handle in which lamps only are to be used. The large "B" regulator controls the current to the "B" switch handle which is arranged to accommodate the pulp tester, cautery and other low voltage heating instruments. The indicating scales are provided to facilitate resetting the regulators once the correct position for the various instruments has been determined. The approximate positions on the regulator scales, at which the various

RITTER UNIT EQUIPMENT - MODEL "E"

instruments on Ritter Unit Equipment should be used, are as follows:

Examination Lamp.....16	
Transilluminating Lamp.....16	Cautery on AC Units.....15
Miscellaneous Instruments...10	Cautery on DC Units.....17

Of course some variation from these figures must be expected, fluctuations in line voltage, causing a variation in current, may make it desirable to adjust the regulators to different positions. Some operators will prefer to work with an instrument at a different temperature than will others. The figures are given merely to enable the operator to more readily locate the ordinary position of the regulators.

To avoid the possibility of burning out the instruments due to excessive current, it is advisable, when adjusting the regulators, to start at the first step on the regulator and advance a step at a time until the instrument controlled by the regulator is receiving the proper amount of current and the desired temperature or brilliancy is obtained.

CAUTION - The switch handle marked "A" is for the lamps only. Do not burn the lamps too brightly. Their brilliancy should be determined in the dark, as daylight, or any conflicting light makes impossible to correctly judge the intensity.

INSTRUMENT SWITCH HANDLES - The instrument switch handles, A and B, are equipped with switches allowing the operator to close the circuit to the instrument by means of a push button for momentary contact, and with a sliding sleeve arranged to keep the instrument "on" indefinitely without the necessity of holding the switch closed. If it is desired to leave the instrument "on" merely slide the Bakelite sleeve on the handle downward away from the instrument.

STRAIN RELIEF CLIPS - The strain relief clips, shown in Figure No. 13, are provided to hold the cords while the switch handles are in use. No special effort is required to slide the cord into the clip when it has been withdrawn to a convenient length. This affords free manipulation of the switch handle unrestricted by the constant retrieving action of the counterweight on the cord.

CALL BELL - A push button for operating the call bell or buzzer is provided on the control panel directly beneath the regulators.

WARM AIR SYRINGE - The warm air syringe is self contained with thumb operated volume and pressure control.

As the operating lever, shown in Figure No. 16, is depressed, the control valve gradually opens admitting an increasing flow of air to the heating chamber. The electrical switch, controlling the current to the heating element, is simultaneously closed as the control valve opens.

The knurled adjusting sleeve on the handle affords a means of restricting the maximum valve opening, when the operating lever is fully depressed, to provide the volume of air best suited to individual operating requirements. Screwing this knurled sleeve toward the handle decreases and away from the handle increases the maximum volume.

CAUTION - As depressing the operating lever also closes the electrical circuit

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to the heating element, do not attempt to operate the syringe until the air supply has been turned on.

If cold air is desired, turn the low voltage switch "off" and operate as instructed on preceding page.

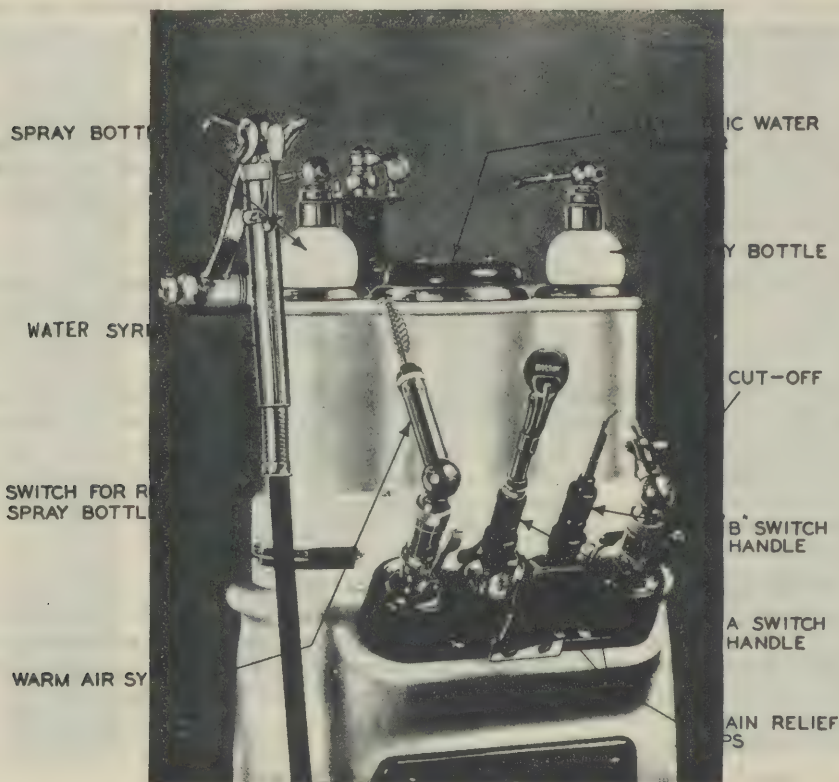


FIGURE NO. 13

CAUTION - Do not operate the warm air syringe without first turning on the air. The heating element is liable to be burned out if heated without air flowing through it.

AIR CUT-OFF - The air cut-off is equipped with the same method of pressure and volume control as the warm air syringe. The knurled adjusting sleeve is also provided on the handle and serves the same purpose as on the syringe.

The cut-off is intended only as a cold air supply for use with the spray bottles, and may be left attached to the spray bottle if desired.

RITTER UNIT EQUIPMENT - MODEL "E"

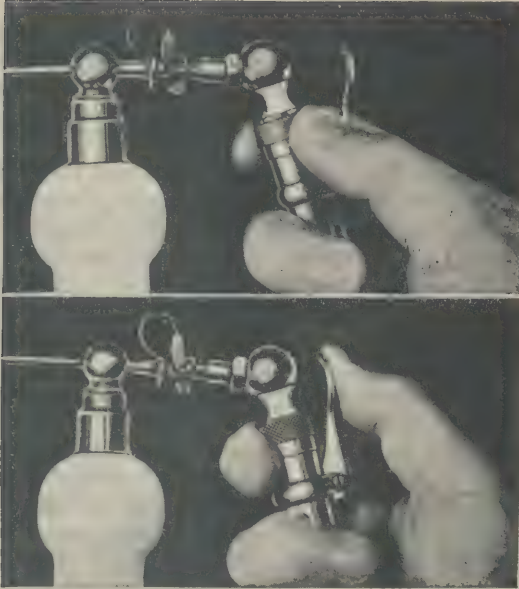


FIGURE NO. 14

These illustrations show the principle of "finger-tip" control as applied to the Ritter Automatic Air Cut-Off and Warm Air Syringe; also, the Thermo-Water Syringe. Upper illustration shows how maximum pressure desired for these appliances can be quickly adjusted with the index finger and thumb. Lower illustration shows additional means of very gradual pressure regulation up to maximum setting.

CAUTERY AND MISCELLANEOUS LOW VOLTAGE INSTRUMENTS - The cautery and various low voltage instruments are also used in the "B" switch handle. The transfer switch, at the bottom of the control panel, must be in the position indicated, otherwise sufficient current to heat the instruments will not be available.

ENGINE AND FOOT CONTROLLER - The foot controller governs the supply of current to the engine and therefore the speed of the bur. A controller with locking device for holding the foot lever at a definite speed is not necessary, and while controllers are made so that they may be used either with or without the locking feature, it is recommended using them without this so the lever returns to the "off" position the instant the foot is removed, otherwise it is impossible to have the motor under perfect control.

It is not annoying or troublesome to hold the controller lever with the foot while operating; a few trials will prove this. Changing the speed of the bur while working can be done quickly without taking the handpiece from the mouth to look down to find the controller lever.

To return the controller lever to the central or "off" position, if the locking devices are used, simply touch the pedal with the foot or press down on the button on the controller cover.

SPRAY BOTTLE HEATER REGULATION -

Two spray bottle containers are provided in the spray bottle heater, each having an independent switch for controlling the degree of heat. The regulating levers of these switches have five different positions in which they may be placed, to give practically any desired temperature for the solution contained in the bottles which they control. It is advisable to place the regulator lever in No. 5 position when the unit is first energized to heat the solutions quickly; then when warmed up, place the lever in the position which will keep them at the desired temperature.

AIR SHUT-OFF VALVES -

The air supply for the warm air syringe and air cut-off may be shut off by means of the two needle valves located inside the Unit near the base. See Figure No. 1A. The valve on the right, facing the back, controls the warm air syringe supply, the one on the left controls the air cut-off supply.

PULP VITALITY TESTER -

The pulp vitality tester electrode is operated in the "B" switch handle on the Unit. This switch handle is controlled by the regulator marked "B" on the control panel. The transfer switch, located at the bottom of the control panel, must be in position marked "For Pulp Tester".

RITTER UNIT EQUIPMENT - MODEL "E"

To throw the locking devices entirely out of use, so the foot lever returns automatically when the foot is removed, press the buttons down and turn them until they come to a stop. This can be done with the foot by striking the edge of the buttons and sliding the foot along.

WATER SYRINGE AND HEATER - The construction of the water-syringe and Heater is illustrated in Figures Nos. 18 and 19. The heater arrangement affords a supply of either warm or cold water for the syringe by means of a selective valve which is provided on the reservoir. This valve is operated by a small lever. If the lever is placed on "Maximum Heat", the water is drawn from the reservoir and is maintained at the proper temperature by automatic thermostatic control. And, as a means of providing instantaneous warm water at the syringe nozzle, a second heating element is incorporated in the syringe handle. This element is independently controlled by the cylindrical regulator located to the rear of the heater. When first preparing the equipment for operation, set the regulator on the ninth step from the top as indicated by the horizontal markings, just above the rotating ferrule, on the front of the stationary section of the regulator. Make certain that the current and water are turned on; then press the operating lever on the handle and check the temperature of the water discharged from the nozzle. If cooler than desired, then turn the regulator ferrule to the right, as indicated by the arrow, until the desired temperature is attained. Furthermore, the temperature of the water may be varied to suit various operating requirements by setting the selective valve lever at intermediate points, as indicated by the temperature control scale on the indicating plate. When operating conditions manifest the use of cold water, turn the selective valve lever to "Maximum Cold"—this delivers cold water to the syringe directly from the supply pipe—and turn the low voltage switch "off" to prevent heating in the syringe handle.

The supporting arm for the water-syringe also acts as a lever for operating the main supply valve on the reservoir. The water, either warm or cold, first goes through the selective valve and is then directed to the main valve, which should always be closed when the water-syringe is not in use, by moving the supporting lever to the extreme low position, but not forcibly. Keeping the main valve closed excludes water under pressure from the syringe hose. When the water-syringe is to be used, raise up on the supporting arm at the same time removing the water-syringe. This opens the valve and releases water to the syringe. When replacing the water-syringe after using, reverse the action, drawing down the supporting arm until the valve is closed. A little practice will make these actions entirely automatic. When opening the main valve, do not attempt to regulate the volume of water flow at this point. This is accomplished by means of a regulating device incorporated in water-syringe.

As previously explained in describing the warm air syringe, the volume and pressure gradually increase as the operating lever is depressed. Also, screwing the knurled sleeve towards the handle decreases and the opposite way increases the maximum volume which may be graduated from a full stream to a gentle drip. Figure No. 18 illustrates the construction of the water-syringe.

The nozzle on the water-syringe may be rotated to any desired position by the operator. This is accomplished by merely grasping the nozzle and turning it.

MAINTENANCE

VALVE PACKINGS - Valve Packings will give service for a long period of time. When the occasion demands, they may be tightened by means of the packing nuts which are provided on the various valves. When tightening the packing nuts do not draw them down more than is necessary, but merely enough to stop any leak. After several

RITTER UNIT EQUIPMENT - MODEL "E"

adjustments have been made and the packing nut has been screwed down as far as it will go, it will be necessary to replace the packings. Ritter Packings should be used when making replacements as they are designed to meet the particular requirements of the various valves.

WARM AIR SYRINGE - The warm air syringe may, after a period of service, require minor adjustments. Refer to Figure No. 15 and observe the following instructions: Close the air valve on the back of the Unit, see Figure No. 1A, and turn off the supply current before attempting any adjustments:

Control Valve. This valve controls the flow of air through the syringe and being under constant spring pressure, may be disregarded unless the rubber valve becomes badly worn and fails to hold. In this event the valve must be replaced as follows: Unscrew the spring hose protector from the syringe handle and, gripping it with the hand, draw the hose and mechanism back out of the handle and unscrew the hexagonal hose tip. Remove the screw, which attaches the wire to the connection terminal, and remove the terminal spring and valve from the valve body. Install the new valve, making certain that the filter screen is in place as illustrated and that the compression rod enters the socket in the valve stem. Reassemble the parts in their respective positions, being sure the hose tip is tight against the connection terminal and that the screw for attaching the wire does not touch the valve body. See Figure No. 15.

Head Packing. Should a leak develop around the head packing, back off the spring hose protector sufficiently to release the pressure against the operating lever, then remove the lever. The head assembly may now be removed from the handle. The packing gland, contained in the head body, is now accessible for tightening, or, if necessary, a new packing may be installed by removing the gland and digging out the old packing with a pointed instrument.

Switch and Valve Adjustments. Both the compression rod, which operates the air control valve, and the electrical switch are adjusted at the factory and unless disturbed should require no further attention.

However, if adjustments are necessary, provision is made to compensate for any condition which may arise.

To insure positive closing of the valve, when the operating lever is released, a little clearance must be allowed between the end of the compression rod and the socket in the control valve stem. An adjusting screw on the end of the rod, is provided for this purpose. Removing the head assembly, as previously explained, will permit access to the screw.

The adjustment of the electrical contact switch should be such that as the operating lever is depressed the air valve opens slightly before the switch closes. This releases a small amount of air to the heating chamber before the current is turned on, thus preventing overheating.

The proper adjustment of the valve and switch may be attained in the following manner: With all parts assembled to the handle, turn the knurled adjusting sleeve toward the handle, until the operating lever is held in the extreme high position, then turn adjusting sleeve one full turn away from the handle and set the adjusting screw for the compression rod so that when the operating lever is depressed, as far as the adjusting sleeve permits, the end of the rod just touches the control valve. Now turn the knurled adjusting sleeve one-half to three-quarters of a turn more away from the handle and adjust the spacing of the electrical switch so that when the operating lever is depressed the spring contact will just close the circuit.

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Securely tighten the set screw (See Figure No. 15) to maintain the adjustment. The knurled sleeve may now be adjusted to provide the volume of air desired.

Hose Replacement. To replace the warm air syringe hose, remove the back cover of the Unit and remove the wires leading to the insulating joint, then unscrew the union nut on the upper end of the insulating joint, after which the hose protecting sleeve and hose should be removed from the lower end of the insulating joint. The syringe may now be taken out of the Unit. Unscrew the hose protecting spring from the handle and, gripping it with the hand, draw the hose out until the hexagonal tip is exposed. Remove the old hose and assemble the new one, being sure the hose tip is tight against the connection terminal and that the screw, which holds the wire, does not touch the valve body. Pass the new hose around the counterweight pulley before reassembling to the insulating joint. Reassemble the insulating joint to the Unit and connect the wires to the insulating joint, making certain the white and black wires are properly connected as shown in Figure No. 17.

Heating Element Replacement. Remove the nozzle by unscrewing the nozzle base. This will expose a screwdriver slot in the end of a copper tube which contains the heating element. It can be removed by unscrewing with a screwdriver. Turn the new heating element into position, without using too much force, so it fits snugly.

Before replacing the nozzle, heat the syringe by pressing the operating lever (first making sure the air pressure is on) and while in this heated condition, tighten the heating element a trifle more until it seats properly. Then replace the nozzle base in its original position.

Filter Screen. The syringe has a filter screen which may need cleaning should it become apparent that the volume of air passing thru the syringe has diminished. To clean, unscrew the spring hose protector, remove the hose and connection terminal and clean the filter screen. Refer to Figure No. 15.

AIR CUT-OFF - The construction of the air cut-off mechanism is shown in Figure No. 16. Unavoidable wear, due to long service, may be compensated for, as outlined in the following instructions. Close the valve on the back of the Unit before making any adjustments. See Figure No. 1A.

Control Valve. This valve controls the flow of air through the cut-off and being under constant spring pressure, may be disregarded unless the rubber valve becomes badly worn and fails to hold. In this event the valve must be replaced as follows: Unscrew the spring hose protector from the handle, draw the hose and mechanism back out of the handle and unscrew the hexagonal hose tip. Using a screwdriver, remove the hollow screw from the valve body, then take out the old valve.

When reassembling the various parts, be sure the compression rod enters the socket in the control valve stem and that the filter screen is in place in the hollow screw.

Head Packing. If a leak develops around the head packing, it must be replaced. Back off the spring hose protector sufficiently to relieve the pressure against the operating lever and remove the lever. The head assembly may now be withdrawn from the handle. Unscrew the packing nut, Figure 16, and remove the old packing. After assembling the new packing in the head, be sure to insert the metal washer before assembling the packing nut. Tighten the packing nut firmly, but not forcibly, since too great a pressure may expand the opening in the packing and cause leakage.

Valve Adjustment. To insure positive closing of the valve when the operating lever is released, a little clearance is necessary between the end of the compression

RITTER UNIT EQUIPMENT : MODEL "E"

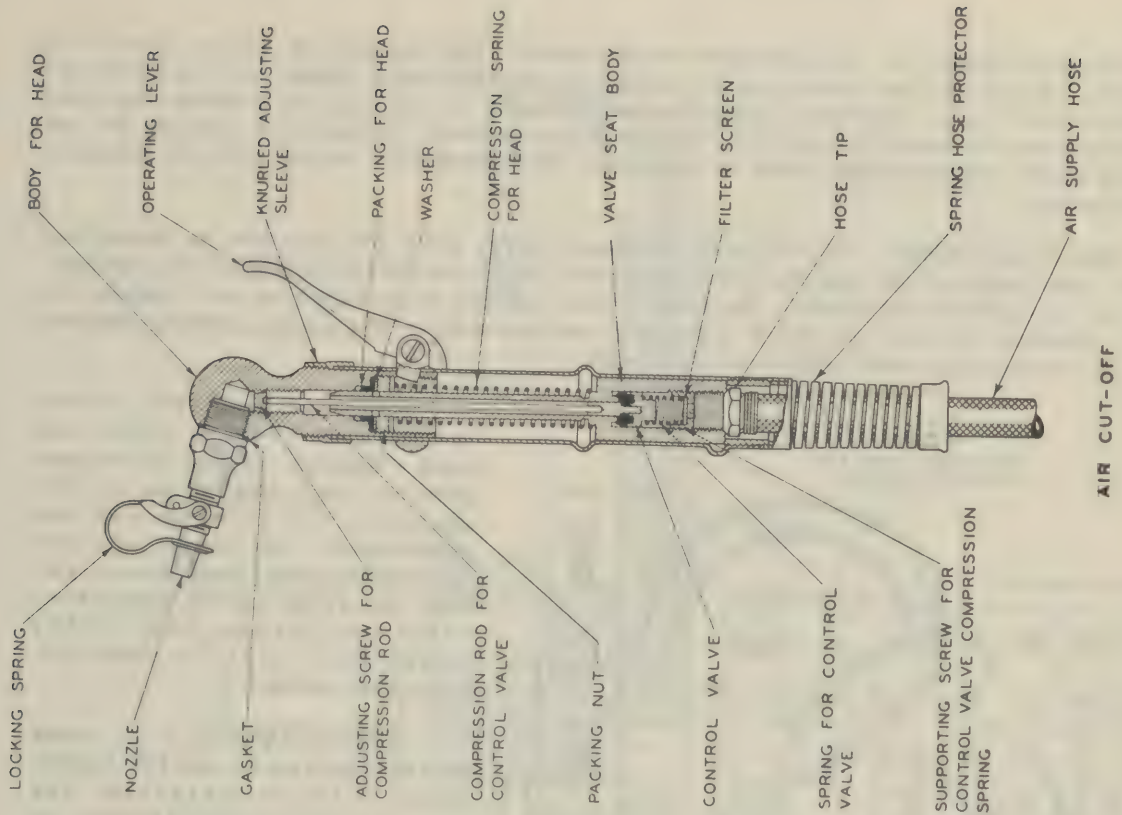


FIGURE NO. 15

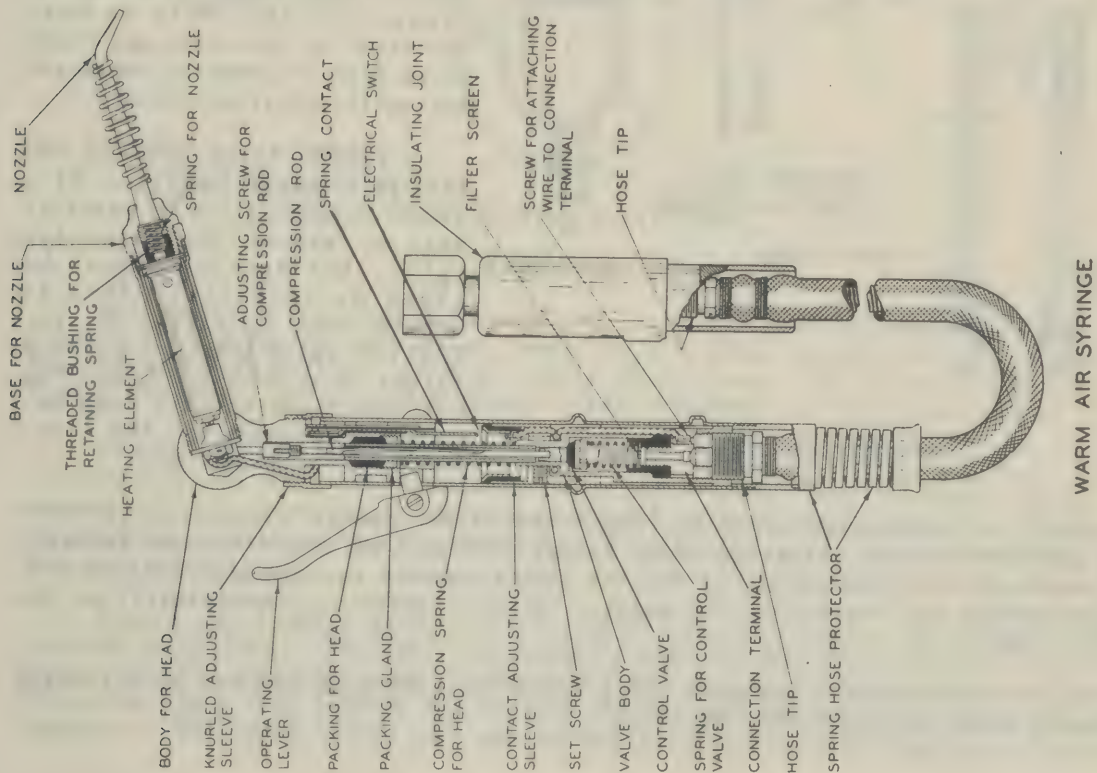


FIGURE NO. 16

RITTER UNIT EQUIPMENT - MODEL "E"

rod and the socket in the control valve stem. The adjusting screw, for this purpose, is set at the factory and unless accidentally disturbed, will require no further attention. However, should an adjustment be necessary, remove the head assembly, as previously explained, insert a screwdriver through the opening in the packing gland and turn the screw to the right to increase or to the left to decrease the clearance.

Hose Replacement. To replace the hose, first shut off the air as explained above, then unscrew the spring hose protector, draw the hose out until the hexagonal tip is exposed and remove the hose. Unscrew the hose coupling nut inside the Unit. Replace the old hose with a new one and reassemble the parts, making certain that all connections are tightened securely.

Filter Screen. The cut-off has a filter screen which may need cleaning should it become apparent that the volume of air passing thru the cut-off has diminished. To clean, unscrew the spring hose protector, remove the valve spring supporting screw and clean the filter screen which will be found inside the screw.

SWITCH HANDLES - If a new switch handle, or switch handle cord is to be installed, the connections should be made to connection block as shown in Figure No. 17. This is very important as the white and black wires must be properly connected for satisfactory operation.

THERMO WATER-SYRINGE AND ELECTRIC WATER HEATER - If a slight accumulation of water is noticed around the selective valve, the packing should be taken up slightly. This is accomplished by giving the selective valve packing gland a slight turn with a wrench. Do not turn down tighter than necessary to overcome the leak. Refer to Figure No. 19.

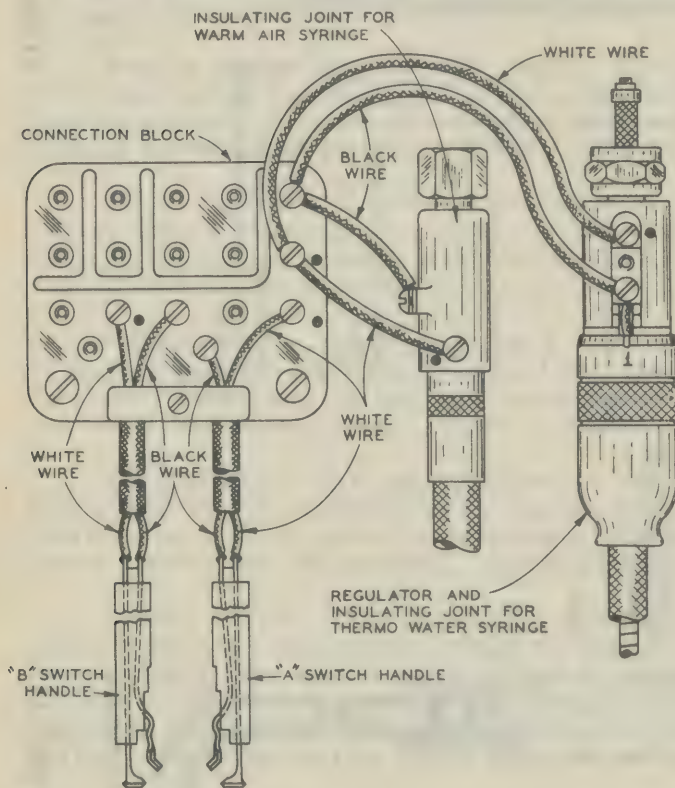
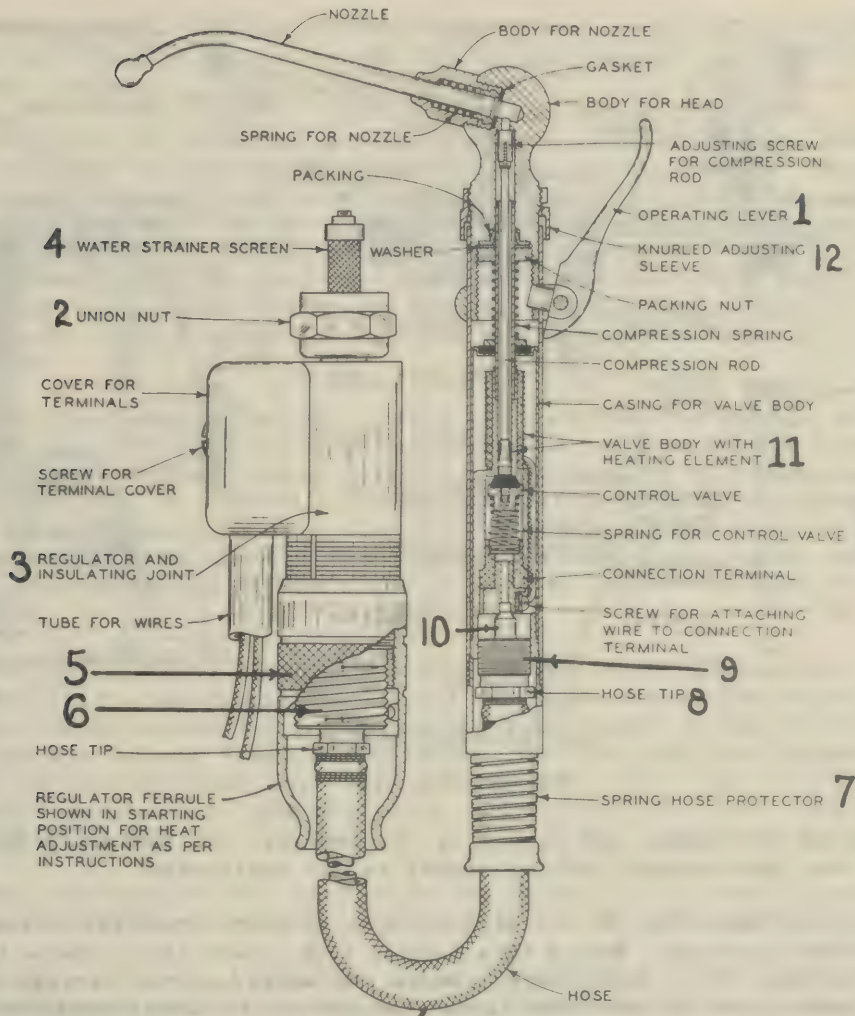


FIGURE NO. 17

Should it become necessary to repack the valve, remove the selective valve screw and take off the selective valve lever. The packing gland is then removed, after which the old packing may be dug out with a pointed instrument. Replace with the new packing and reassemble the parts. Do not tighten up unnecessarily on the packing gland.

Main Valve Packing. The main valve is of the bibb type and the construction is plainly shown in Figure No. 19.

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THERMO-WATER SYRINGE

FIGURE NO. 18

Adjustment of this valve is required when, in order to close the valve, it is necessary to drop the supporting lever for the water-syringe to such a low point that the syringe will not readily remain on the hook. To adjust the support to a higher position, proceed as follows, first referring to the illustration.

Remove the screw, which holds the main valve stem wedge in place. Using a screwdriver, or some similar instrument, as a lever, pry the wedge loose, disengaging the teeth on the wedge from the teeth on the syringe support. The support may then be raised to the proper position or height after which the wedge should be reassembled.

Should the packing ever wear to a point where it can no longer be taken up, proceed as follows: Shut off the water by means of the shut-off cock provided on Model "E" Unit cuspidor arm. Unscrew the bonnet for the main valve, as shown in Figure No. 19. This removes the syringe support and the valve mechanism all in one assembly. The valve washer can then be replaced merely by loosening the retaining

RITTER UNIT EQUIPMENT - MODEL "E"

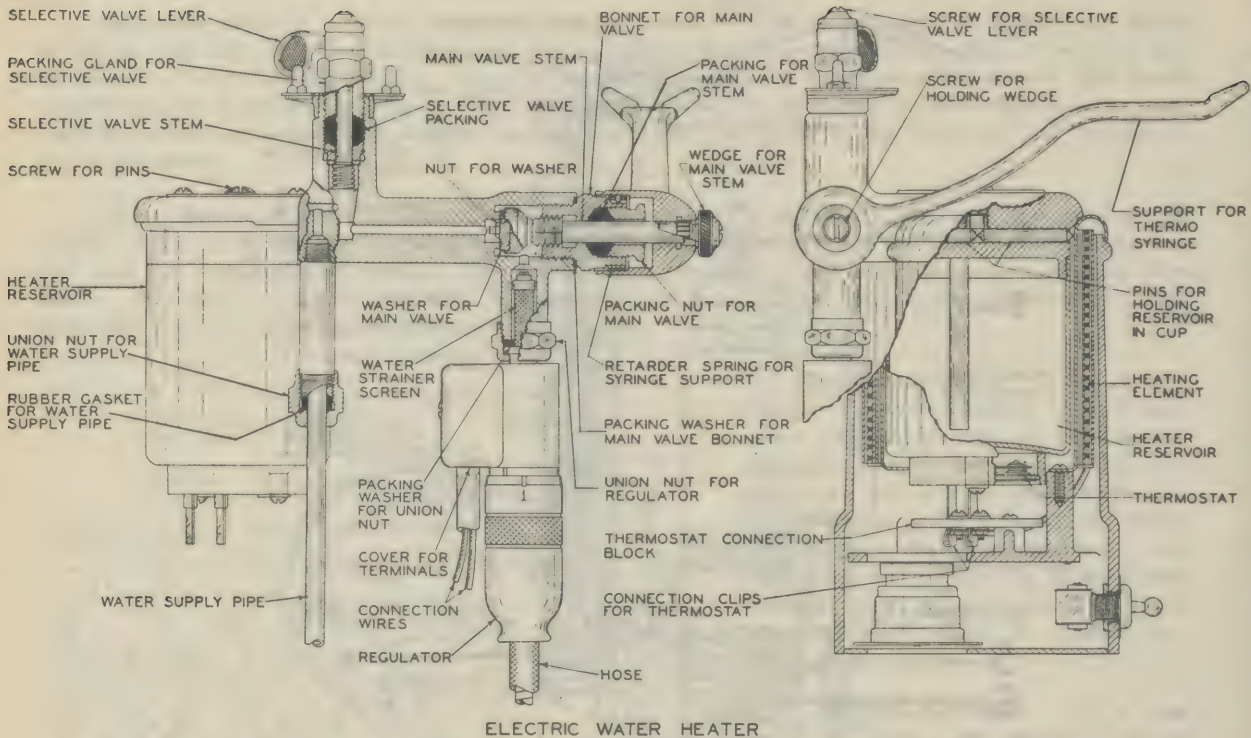


FIGURE NO. 19

nut, removing the old washer and inserting the new one. In replacing the parts, make certain the valve bonnet packing washer is not overlooked.

Referring to Figure No. 19, it will be noticed that a packing for the main valve stem is also provided. Should this packing leak at any time, remove the screw which holds the main valve stem wedge, remove the wedge and the syringe support. The internal packing nut for the main valve stem packing is then accessible and may be tightened sufficiently to overcome the leak. If, in time, this packing cannot be taken up further, it must be replaced. This is accomplished by removing the internal packing nut entirely. The old packing is then removed, the packing is inserted and the parts are replaced. Be careful not to tighten down on the new packing more than is necessary.

Water-Syringe Packings. Two packings are used in the water-syringe: the for the syringe head and the control valve packing which controls the flow of water entering the syringe, see Figure No. 18. Be sure to turn off the current and water before disassembling the syringe. The packings should be serviced in accordance with the following procedure:

Head Packing. If a leak develops around the head packing, it must be replaced. Back off the spring hose protector sufficiently to relieve the pressure against the operating lever and remove the lever. The head assembly may now be withdrawn from the handle. Unscrew the packing nut, Figure 18, and remove the old packing. After assembling the new packing in the head, be sure to insert the metal washer before assembling the packing nut. Tighten the packing nut firmly, but not forcibly, since too great a pressure may expand the opening in the packing and cause leakage. When reassembling the parts, be sure the compression rod enters the socket in the control valve stem.

RITTER UNIT EQUIPMENT - MODEL "E"

Control Valve. The take-up on this packing is entirely automatic and should require no attention unless a leak develops in the syringe and a new packing is necessary.

To replace the packing, unscrew the spring hose protector from the syringe handle and draw the hose and mechanism back out of the handle. Unscrew the hexagonal hose tip and slip the metal casing off the other end of the valve body, see Figure No. 18. Remove the screw which attaches the wire to the connection terminal and remove the terminal, spring and valve from the valve body. Install the new valve and reassemble the parts in their respective positions, being sure the hose tip is tight against the connection terminal and that the screw for attaching the wire does not touch the valve body. The compression rod must enter the socket in valve stem.

Valve Adjustment. To insure positive closing of the control valve, when the operating lever is released, some clearance is necessary between the end of the compression rod and the socket in the valve stem. The adjusting screw, provided for this purpose, is carefully set at the factory and, unless accidentally disturbed, will require no further attention. However, should an adjustment be necessary, remove the head assembly as instructed and turn the adjusting screw on the end of the compression rod to the right to increase or to the left to decrease the clearance.

Hose Replacement. Remove the screw which holds the terminal cover on the insulating joint (see Figure No. 18) and detach the connection wires. Unscrew the union nut, using wrench No. 2. Unscrew both the spring protector from the syringe handle and the ferrule from the regulator. The hose tips, now exposed, may be unscrewed and the new hose assembled. Be sure the hose tip is tight against the connection terminal and that the screw, which holds the wire, does not touch the valve body.

When reassembling the syringe to the heater, it is very important that the black, and white wires be connected properly, as shown in Figure No. 17.

Strainer Screen. A strainer screen is attached to the upper end of the regulator and insulating joint. Occasionally this assembly should be removed, as just explained, and the screen cleaned.

Refer to Figure No. 17 when connecting the black, and white wires to the insulating joint.

Broken or burned-out resistance located on reservoir end of syringe hose. (See Figure No. 18.)

Procedure:

- 1st - Shut off water from syringe by pulling syringe support lever all the way down.
- 2nd - Drain excess water from syringe by pressing on operating lever (1).
- 3rd - Unscrew union nut (2) releasing regulator and insulating joint (3) from reservoir. Pull out gently, being careful not to damage water strainer screen (4).
- 4th - Unscrew regulator ferrule (5) and allow it to slide down on syringe hose.
- 5th - Inspect the resistance winding (6) for broken or burned-out wires. If so, replace with new resistance.

NOTE: If the resistance wires are not broken or burned out, reassemble the syringe to Unit reservoir and continue checking as follows:

RITTER UNIT EQUIPMENT - MODEL "E"

Syringe hose may have broken a wire.

Procedure:

- 6th - Unscrew spring hose protector (7) from syringe handle and allow it to slide down on the syringe hose.
- 7th - Pull on syringe hose, removing it and syringe body from syringe handle.
- 8th - Unscrew syringe hose tip (8) from syringe body, using two wrenches.
- 9th - Test for broken wire in syringe hose by rocking screw driver over thread end (9) of hose and the contact tip (10) being sure that current at Unit is turned on. If there is no electric spark, it is proof that wire in syringe hose is broken and a new hose is necessary. If there is an electric spark, it is proof that the syringe hose and its wiring are in working order. Do not reassemble syringe but continue checking as follows:
- 10th - Examine resistance or heating element (11), on stem part of syringe body, for broken wire. If wire is broken it will be unraveled and loose. If burned out, the entire heating element will have turned black. In either event a new syringe body is necessary.

NOTE: If the ten steps described have been carefully followed and the failure of the syringe to give warm water still remains, it would indicate that the trouble is not the syringe, but somewhere in the Unit. Such cases, however are very remote. The trouble is most always found in one of the ten checking-up steps as outlined.

OILING DENTAL ENGINE - The two motor bearings that require oiling are provided with large self contained wicks holding quite an amount of oil.

Surplus oil, working out of the ends of the bearings, is picked up by the wicks running lengthwise, from end to end, of the bearing bushing. These return the oil to the main supply wick, maintaining constant circulation.

Just how often the engine should be oiled must be based on judgment. Never oil so much that the excess is thrown all over the inside of the motor.

To oil the bearings, place the engine arm vertical so the shaft of the motor is practically level. Place a few drops of engine oil in the oil hole in each bearing.

IMPORTANT - Due to the special oiling system, only dental engine oil should be used with a dental engine.

BRUSH ADJUSTMENT AND REPLACEMENT - The brush holder is set at the factory to provide the proper spring tension for the brushes. This adjustment should not be disturbed unless it becomes absolutely necessary, as it requires considerable skill to adjust these brushes to insure perfect commutation. Too great a pressure will wear the brushes rapidly, and not enough tension will result in faulty operation.

In the event it becomes necessary to make an adjustment of the brushes, refer to Figure No. 20, which shows the commutator and brushes on Alternating Current motors.

The commutator is the copper cylinder on which the carbon brushes bear. To adjust the spring tension of the brushes, hold the stud marked B, with a screw-driver, and loosen the nut marked C, with a wrench. Turn the stud B until the desired tension is attained, then, still holding stud B in position with the screw-driver, tighten nut C which locks the adjustment.

RITTER UNIT EQUIPMENT - MODEL "E"

The carbon brushes need replacing only when they have worn down enough to allow the stop pin, on the brush holder arm, to strike. The brushes can be replaced by removing the screws marked A, and substituting the new brushes for the worn ones. It is well to cut a piece of No. 0 sandpaper 3/8 in. wide and about 3 in. long and place it under the brushes with the smooth side to the commutator. Move back and forth, at the same time holding the brushes down slightly. This shapes them to the commutator. New brushes usually make a little noise until they are worn in. Never attempt to readjust the tension of the brush holders when placing new brushes in the engine, as it is unnecessary.

Should the engine run unsteadily at any time, it is very likely due to a dirty commutator; clean it with a soft cloth. Never use oil or vaseline on the commutator.

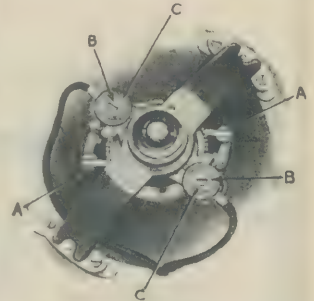


FIGURE NO. 20

FOOT CONTROLLER - The foot controller should be opened about every six months and the metal contacts examined.

The plates must always have a small amount of vaseline on them to avoid excessive wear. Sometimes this dries up, and as a result, the brushes which rub on these plates may begin to cut.

To remedy this, follow the complete instructions pasted on the under side of every controller cover.



FIGURE NO. 21

BRUSH ADJUSTMENT AND REPLACEMENT ON ROTARY CONVERTER - The adjustment of the spring tension on the Rotary Converter brush holder should be left undisturbed for the same reasons as those set forth in the paragraph devoted to the engine brushes. However, in the event it becomes necessary to make an adjustment of the brushes, refer to Figure No. 21. To adjust the spring tension, hold the knurled nut marked D and loosen the hexagon nut marked C. Turn the knurled nut D until the proper tension is attained, then, holding the knurled nut D in position, tighten nut C, which locks the adjustment.

The carbon brushes need replacing only when they become worn enough to allow the arm, marked F, to strike on the stop lug located on part B. Never readjust the spring tension of the brush holder when putting in new brushes. Never use oil or vaseline on the commutator.

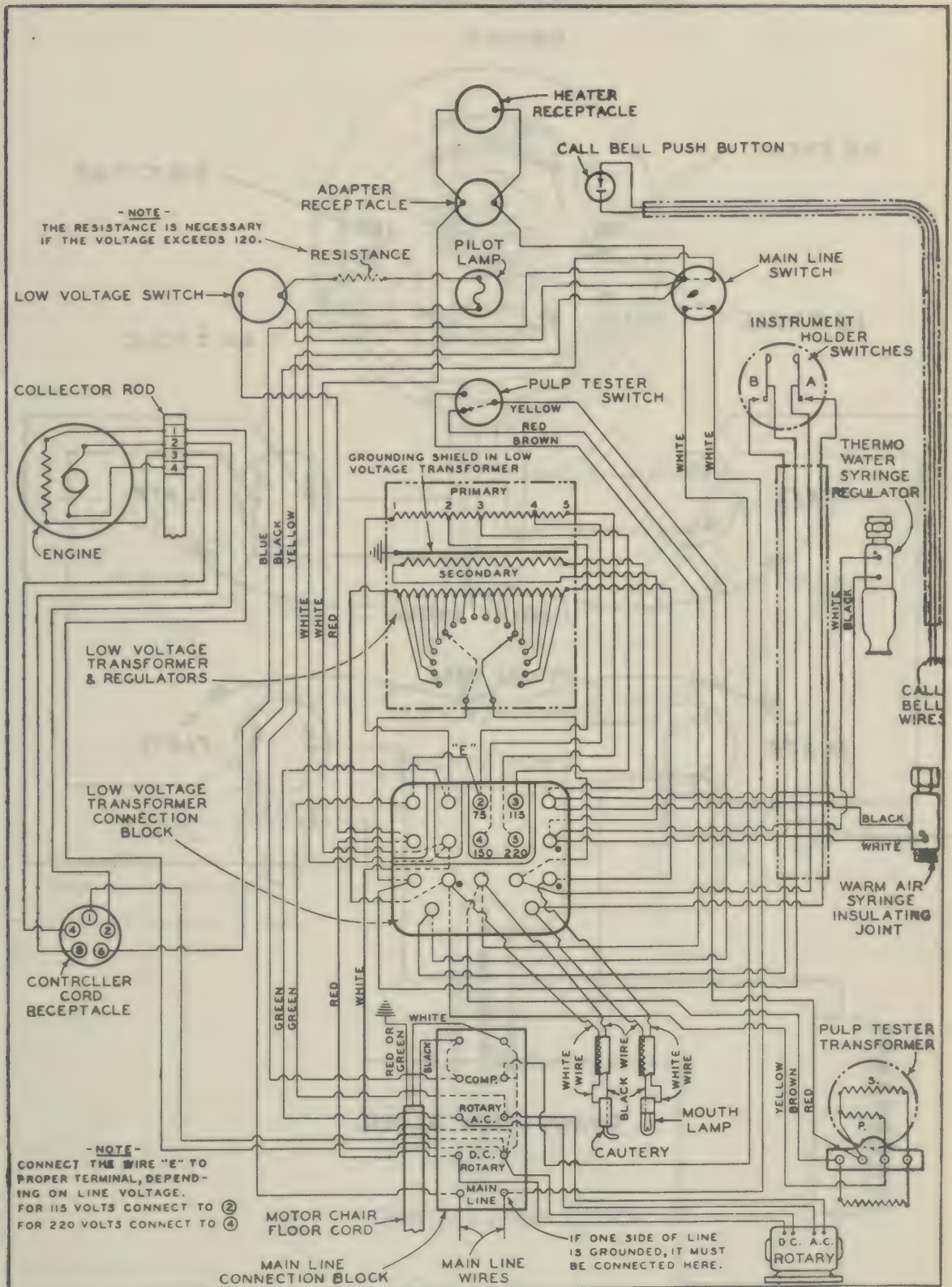
OILING ROTARY CONVERTER - The Rotary Converter should be oiled at least once a month. Oiling will depend largely on how much it is used, so it should be determined in each case by the service it is called upon to give. Use only dental engine oil for this purpose.

WIRING DIAGRAM FOR MODEL "E" UNIT
100 TO 250 VOLTS - 25 TO 60 CYCLES
ALTERNATING CURRENT



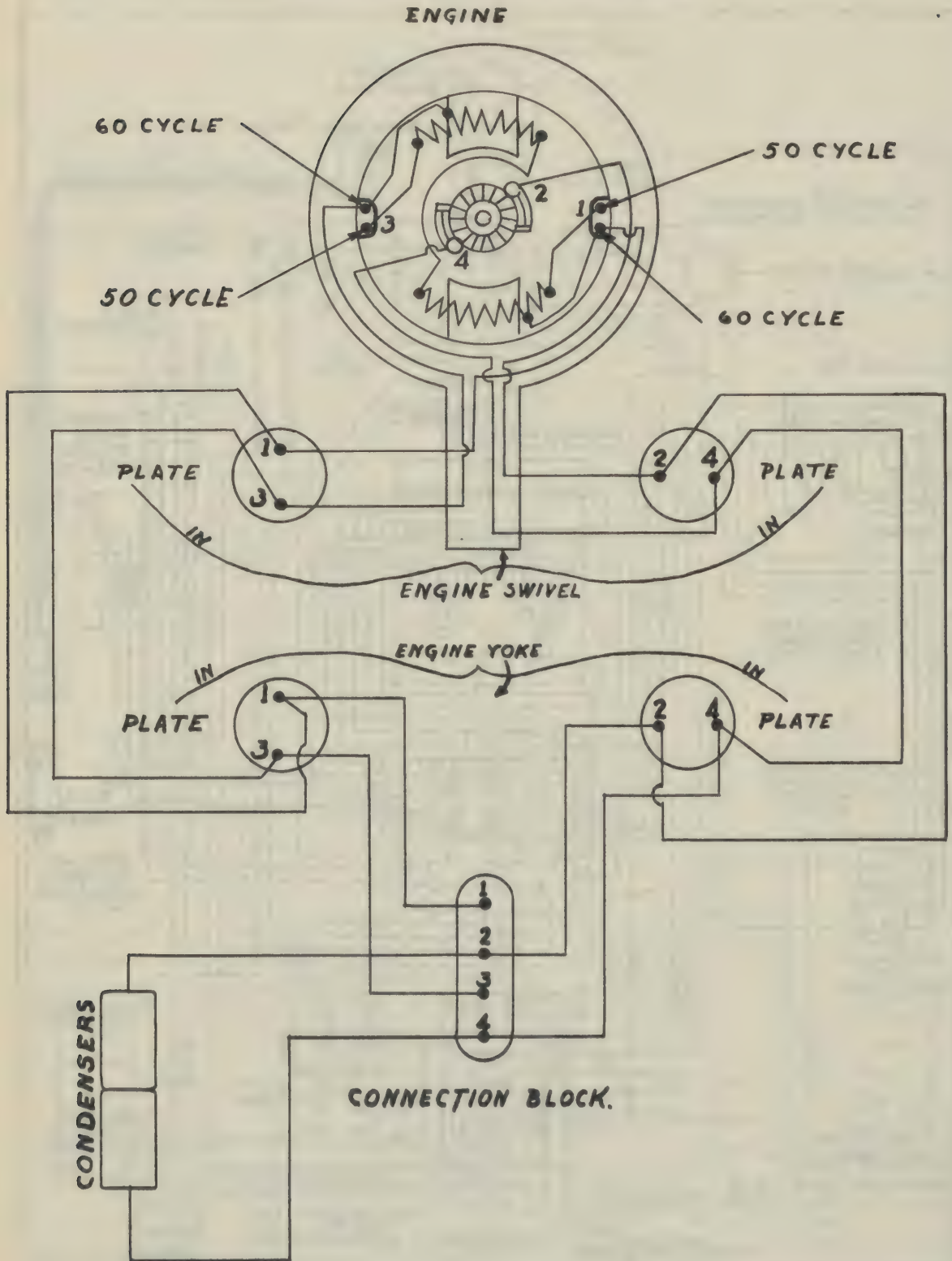
ITTER UNIT EQUIPMENT - MODEL "E"

WIRING DIAGRAM FOR MODEL "E" UNIT 100 TO 250 VOLTS - DIRECT CURRENT



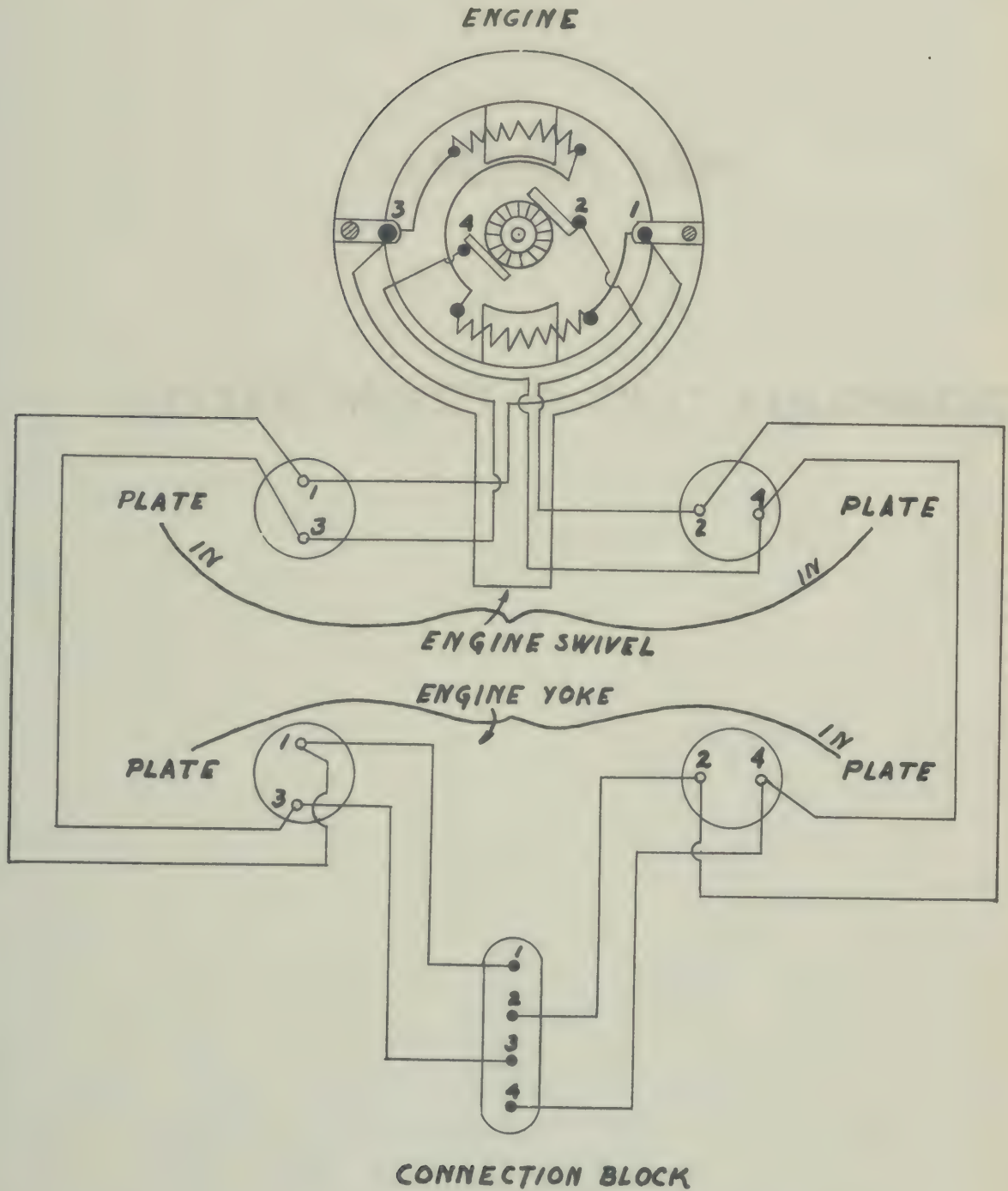
ITTER UNIT EQUIPMENT - MODEL "E"

WIRING DIAGRAM FOR MODEL "C" ENGINE
ALTERNATING CURRENT
FOR RITTER UNITS AND TRI-DENTS



RITTER UNIT EQUIPMENT - MODEL "E"

WIRING DIAGRAM FOR MODEL "C" ENGINE
DIRECT CURRENT
FOR RITTER UNITS AND TRI-DENTS



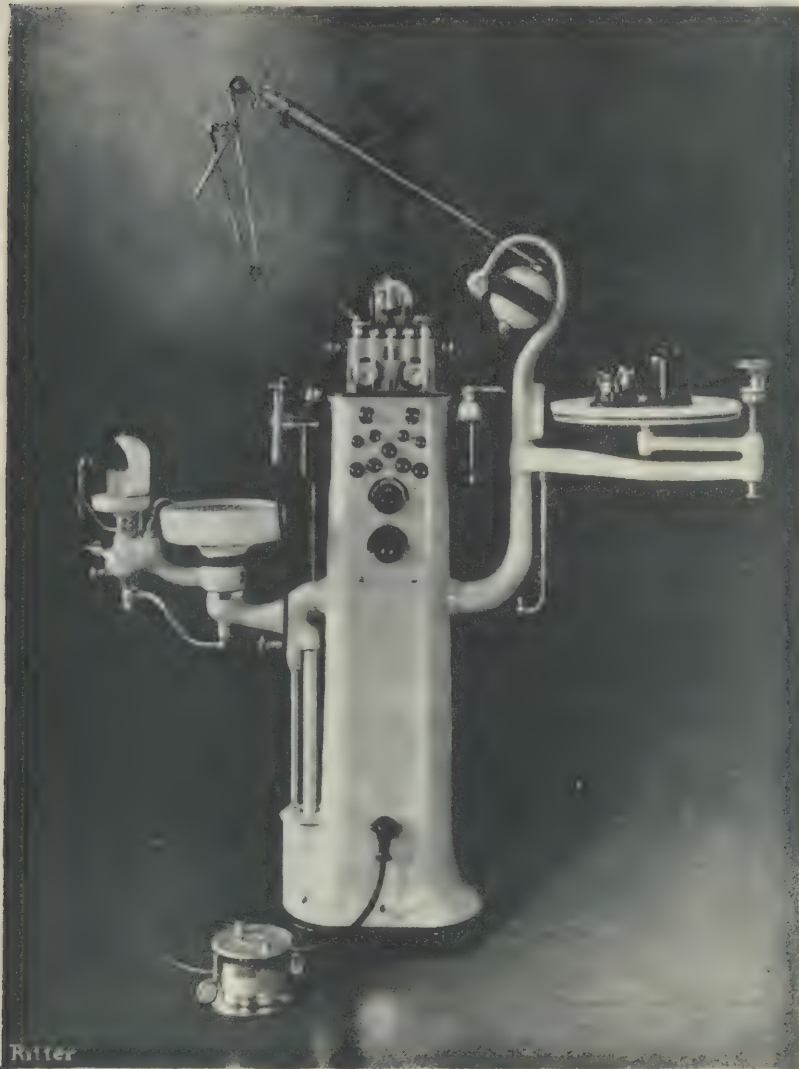
SECTION LXIV

RITTER MODEL D UNIT EQUIPMENT

THE HISTORY OF

THE HISTORY OF THE

RITTER MODEL "D" UNIT EQUIPMENT
INSTALLATION, OPERATION AND MAINTENANCE



IMPORTANT

1. The cotton in the air filter should be changed at least twice a month. See Figure No. 2.

2. When voltage instruments are not in use, shut off the low voltage switch. This opens the circuit to the transformer and on Direct Current Units shuts off the current to the Rotary convertor, thus preventing its running unnecessarily.

ALL SUBJECTS NOT COVERED IN THE FOLLOWING WILL BE ASSUMED TO BE COVERED AS IDENTICAL TO THE MODEL E UNIT. IT IS EXTREMELY IMPORTANT TO NOTE THE FOLLOWING VARIATIONS IN THE CASE OF THE D UNIT.

SUPPLY WIRE CONNECTIONS - After all the water, gas, and air connections are completed, the electrical connections should be made to the terminal block as indicated on printed directions pasted on the block, and shown in Figure No. 1.

RITTER MODEL "D" UNIT EQUIPMENT

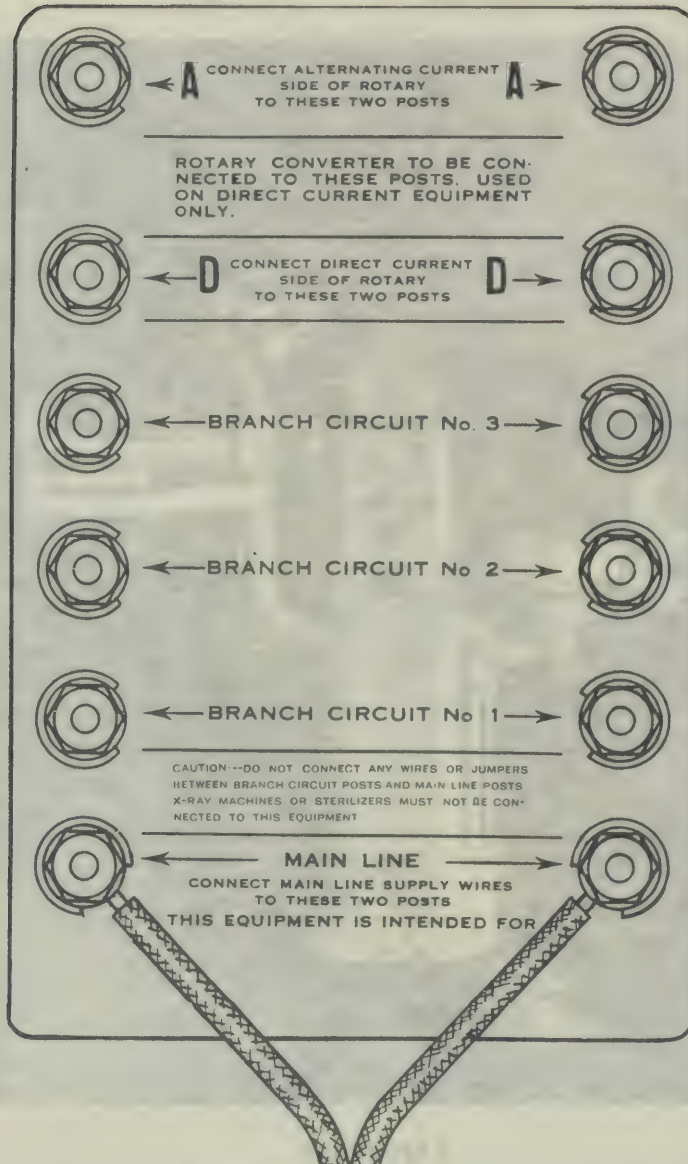


FIGURE NO. 1

It is necessary to place 15 ampere fuses in Alternating Current, or 5 ampere fuses in Direct Current, main supply circuits, as provision is made in the Unit Equipment for branch circuit fuses only.

The name plate on the back of the pedestal, near the top, indicates the kind of current for which the Unit is intended. Make sure current is the same, then proceed to make the necessary connections by means of No. 14 rubber covered wires.

BRANCH CIRCUIT CONNECTIONS - The terminal block and the switches on the face of the pedestal are so arranged that three branch circuits, numbered 1, 2, and 3, may be run from the Unit to any other electrical apparatus designed to operate on full supply voltage, such as a fan, air compressor, laboratory lathe, or operating lamp, and each of these circuits is provided with a switch on the face of the pedestal, so they may be controlled from the Unit. Do not connect an X-ray machine or sterilizer to any of these circuits.

RITTER MODEL "D" UNIT EQUIPMENT

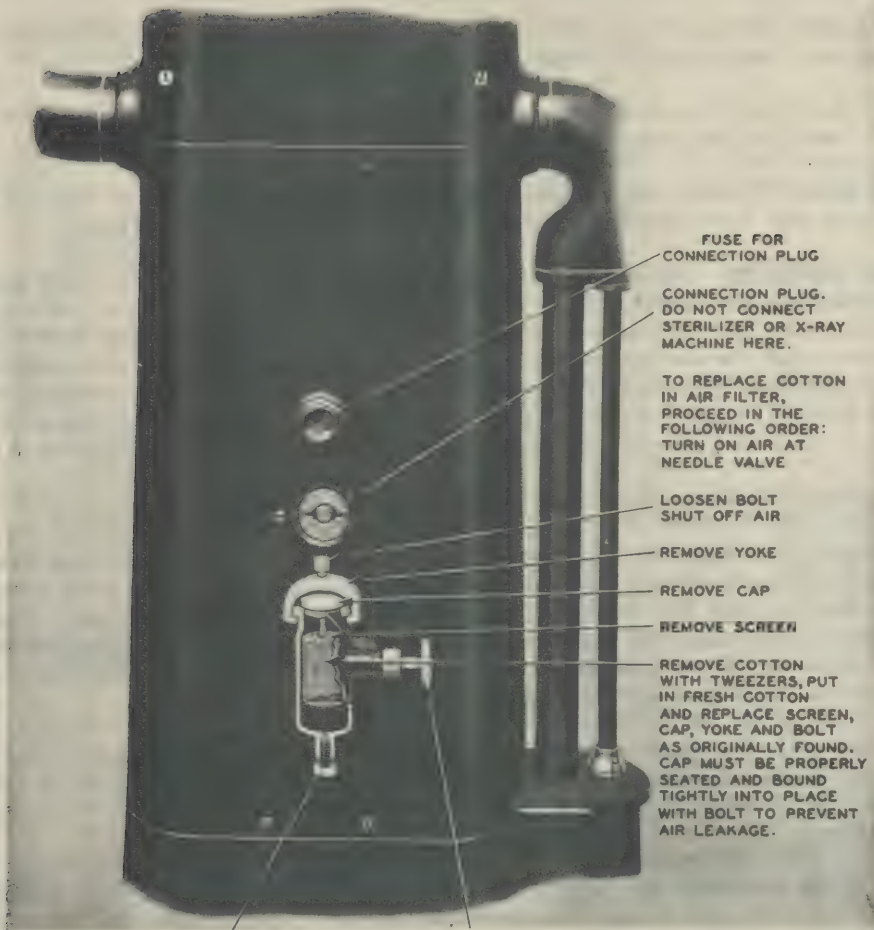


FIGURE NO. 2

PLUG CONNECTION IN REAR OF UNIT - The plug connection on the back of the pedestal is wired to, and controlled by, the main line switch and may be used for any small electrical device intended for full line voltage, such as a small fan.

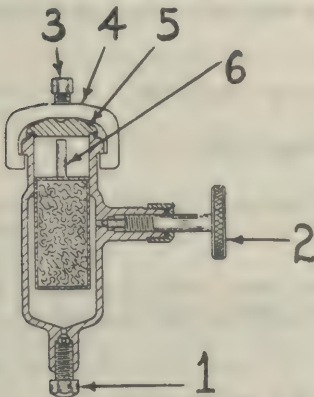


FIGURE NO. 2A

CAUTION - Do not connect the main supply wires with this plug; it is for a branch circuit only. Main supply wires must be connected on the terminal block in the base of the pedestal. See heading "Supply Wire Connections".

CONDUIT WIRING - In wiring for the Unit we recommend the use of conduit work, and to aid in having this done, the following is suggested:

If the Unit is to be operated on Alternating Current and all branch circuits are to be wired, three 1/2 inch conduits are necessary.

RITTER MODEL "D" UNIT EQUIPMENT

If the unit is to be operated on alternating current and no branch circuits are to be wired, then only one conduit is necessary.

If the Unit is to be operated on Direct Current and all three branch circuits are to be wired, then four 1/2 inch conduits are necessary.

If the Unit is to be operated on Direct Current and no branch circuits are to be wired, then two 1/2 inch conduits are necessary.

This layout of conduits is based on the assumption that three No. 14 wires are placed in each 1/2 inch conduit. This is allowed by the Underwriters.

ROTARY CONVERTER - When the Unit is to be operated on a Direct Current supply, it is necessary to use a Rotary Converter in connection with it; this changes the Direct Current to Alternating Current. It may be located in any convenient place in the clinic, and connected to the four upper binding posts on the terminal block in the lower part of the pedestal by means of four No. 14 rubber covered wires, or two No. 14 twin wires, if wiring is all in conduits. Follow the diagram shown in Figure No. 1, also the directions on the name plate of the Rotary Converter.

The Rotary Converter should be oiled at least once a month.

IMPORTANT - *To save the current used by the Rotary Converter, and also to save wear, stop it whenever the low voltage instruments are not to be used for any length of time. The Rotary Converter is used only with Units, operated from a Direct Current supply line, and the current leading to the Rotary Converter is controlled by means of the switch at the upper right hand part of the pedestal, marked, "Switch for low voltage instruments," in Figure No. 9.*

When the Unit is operated from an Alternating Current supply line this same switch controls the current to the transformer. The current used by it, when no instruments are in use, is only 4 watts, so ordinarily the switch is maintained in closed position.

AIR FILTER ON BACK OF UNIT - The purpose of the air filter is to prevent moisture and foreign particles from entering the air instruments on the Unit. It is essential that the filter be drained of accumulated moisture and foreign particles every month and refilled with fresh cotton.

Procedure - (See Figure No. 2A.)

1st - Unscrew by one full turn the needle valve (1) while air pressure is on. Hold tumbler underneath to catch water. When water has completely drained off, retighten the needle valve (1).

2nd - Shut off compressed air by turning inward the needle valve (2).

3rd - Loosen bolt (3) and remove yoke (4), also remove cap (5).

4th - Remove screen (6) also the cotton underneath the screen, using a pair of tweezers to do so.

5th - Put fresh cotton into filter and replace screen, cap, yoke and bolt as originally found. Cap must be properly seated and bound tightly into place with bolt to prevent air leakage.

6th - Turn on compressed air by turning outward the needle valve (2).

RITTER MODEL "D" UNIT EQUIPMENT

CUSPIDOR, ATTACHMENT - IMPORTANT - The water supply valve on cuspidor arm, shown in Figure No. 9 should be shut off every night.

MODEL "A" CUSPIDOR - Clean out plug to be removed and its screen thoroughly cleaned at least once each month.

Procedure: (See Figure No. 3).

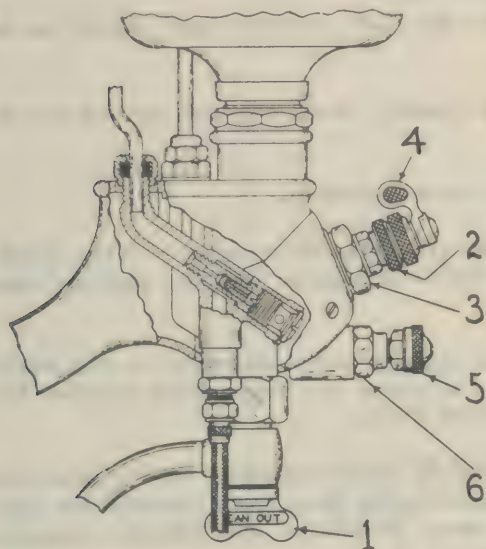


Figure No. 3

1st - Shut off the water supply valve located on the lower cuspidor arm extending from the *Unit pedestal*.

2nd - Place a small pail under clean out plug (1). Remove clean out plug by unscrewing.

3rd - Unscrew knurled cap on the end of the screen.

4th - Flush screen and all parts with clean running water. Depending on the condition of the local water supply and the frequency of cleaning the screen, some of them become so badly clogged up with foreign substance that flushing with water will not thoroughly cleanse. Therefore, it will be necessary to tap the screen holes with a stiff bristle brush or to cleanse the screen with a fine pointed instrument.

5th - Be sure the clean out plug is replaced with all parts as originally found.

After a certain amount of usage, valve packings will naturally wear out. (See Figure No. 3 Master Valve (2).)

Procedure:

1st - Shut off the water supply valve located on the lower cuspidor arm extending from the *Unit pedestal*.

2nd - Turn the master valve (2) to the left to wide open position as far as possible.

3rd - Unscrew the clamping nut (3) with a wrench, being careful not to mar the plating or finish.

4th - Pull out the complete master valve assembly.

5th - The seat packing is found on the end of the master valve assembly stem. Remove the old seat packing with the point of a knife and press the new packing into place.

6th - Before returning the complete master valve assembly to its position in the socket, replace the rubber washer which seals the connection between the valve and the cuspidor core as a precaution against leaks.

RITTER MODEL "D" UNIT EQUIPMENT

7th - When inserting the complete master valve assembly into the socket, tip it a little so the distributing valve packing will not be scratched in passing the small ledge inside the socket. Then tighten the clamping nut (3), being sure the master valve (2) is wide open and the distributing lever (4) is turned up. Otherwise the extreme pressure which will be exerted on the valve seat is likely to damage it.

Tumbler Supply Valve (5).

1st - Turn the tumbler supply valve (5) to the left to wide open position as far as possible.

2nd - Unscrew the clamping nut (6) with a wrench, being careful not to mar the plating or finish.

3rd - Pull out the complete tumbler supply valve assembly.

4th - The seat packing is found on the end of the tumbler supply valve stem. Remove the old seat packing with the point of a knife and press the new packing into place.

5th - Before returning the complete tumbler supply valve assembly to its position in the socket, replace the rubber washer which seals the connection between the valve and the cuspidor core as a precaution against leaks.

6th - When inserting the complete tumbler supply valve assembly to its position in the socket, be sure to securely tighten it by screwing down the clamping nut (6), being sure the tumbler supply valve (5) is wide open. Otherwise the extreme pressure which will be exerted on the valve seat is likely to damage it.

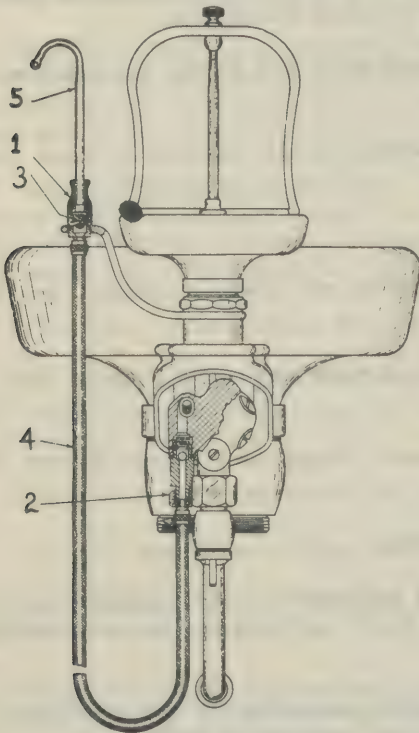


Figure No. 3A

If the saliva ejector fails to provide the necessary suction, there is either an air leak or clogging. (See Figure 3A).

Procedure:

1st - Look for an air leak by being positive the rubber tip (1) on the end of the ejector hose is tight. Often, when inserting the saliva ejector (5) into the rubber tip (1) the ejector is forced down at an angle, thus causing a bulge in the tip (1) allowing air leakage.

2nd - Make sure the union nut connection (2) on the other end of the ejector hose is screwed up tight.

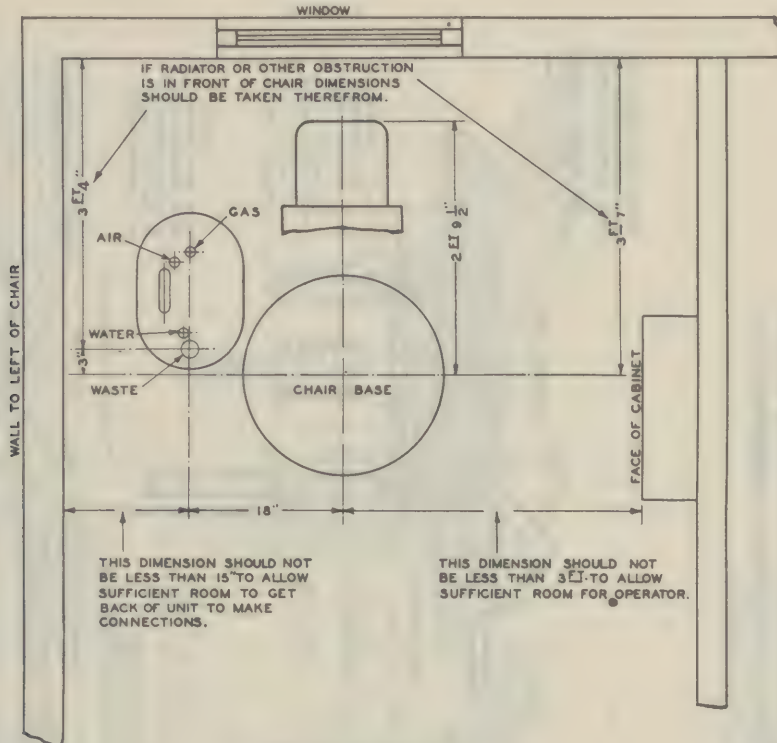
3rd - Clean the screen (3) which will be found by unscrewing the rubber tip (1).

4th - Remove the ejector hose (4) and force compressed air through it at high pressure, using the air cut-off from the Unit to do so.

5th - After cleaning with compressed air, force clean water through the hose.

RITTER MODEL "D" UNIT EQUIPMENT

6th - Reassemble the ejector hose and parts, and test again. If there is still failure of satisfactory suction, the trouble probably is in the ejector nozzle located in the main valve body of the cuspidor.



FLOOR PLAN

Showing location of chair and unit with unit placed to left of chair.

Use this plan for properly locating unit in the room.

FIGURE NO. 4

Diagram showing the relative position of the chair and Unit in an operating room with the Unit at the left of the chair.

NOTE - When placing the chair and Unit in front of a window, the dimensions shown in the cut are the minimum distances allowed. Where the space permits, an increased distance of five or six inches is better.

RITTER MODEL "D" UNIT EQUIPMENT

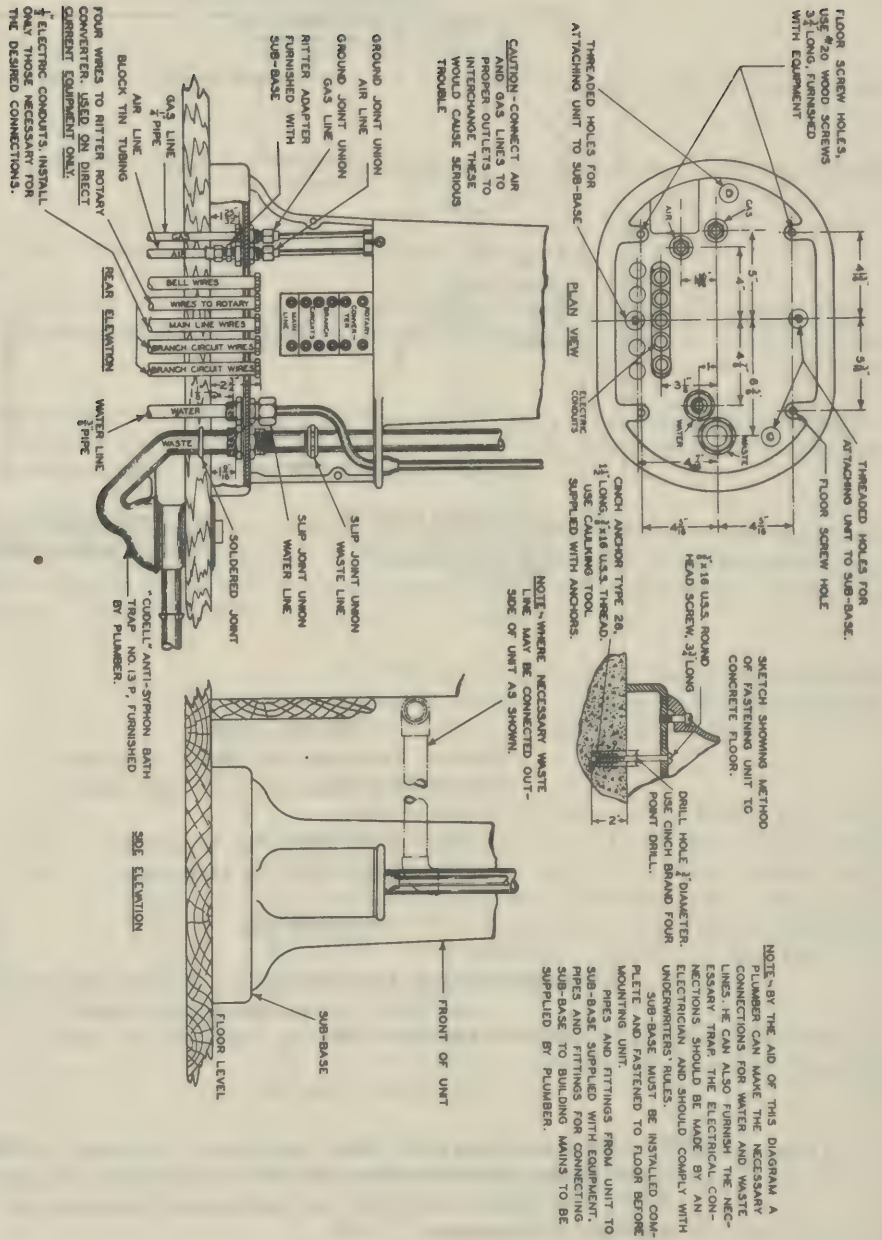


FIGURE NO. 5
Unit equipment installation diagram showing concealed wiring and piping, with bath trap in floor, for model "D" unit with type "A" sub-base.

ITTER MODEL "D" UNIT EQUIPMENT

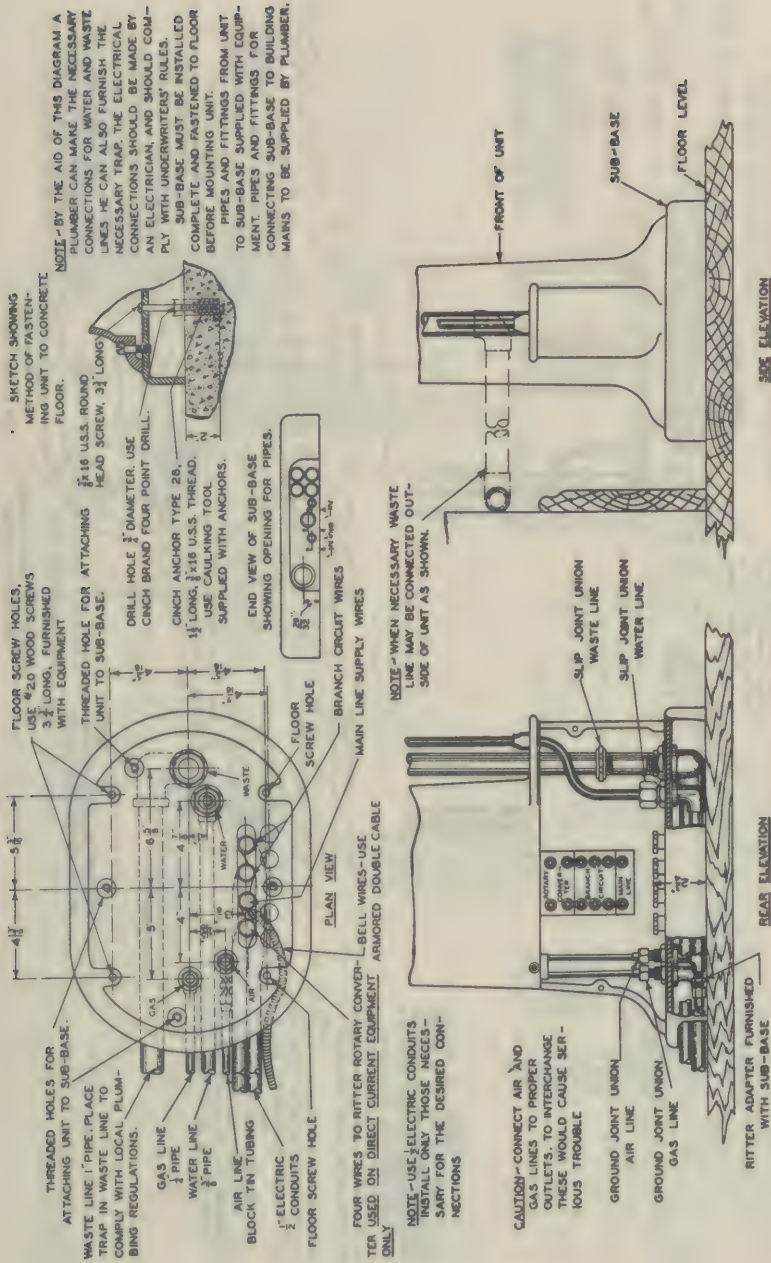


FIGURE NO. 6
Unit equipment installation diagram showing exposed wiring and piping for model "D" unit with type "C" sub-base.

RITTER MODEL "D" UNIT EQUIPMENT

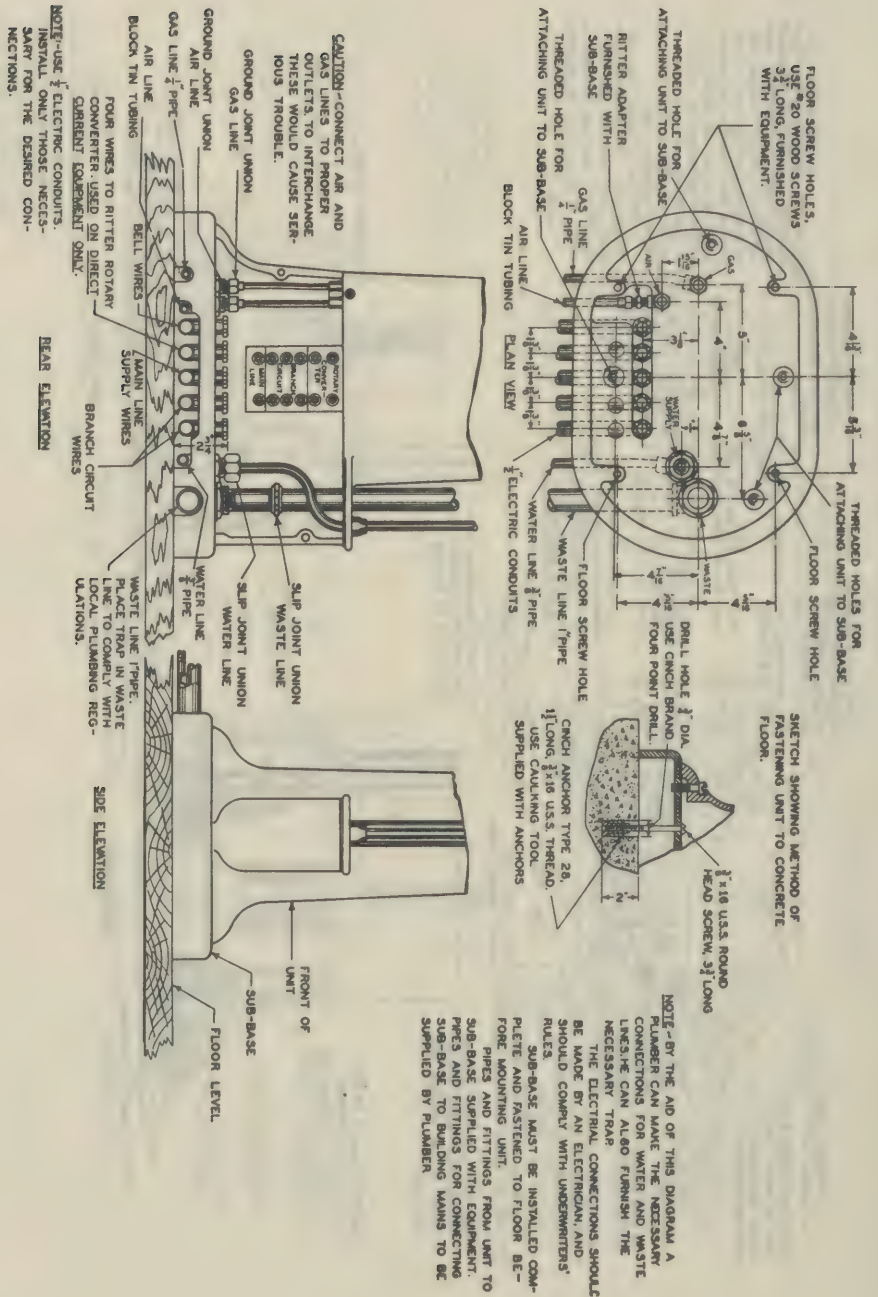


FIGURE NO. 7

Unit equipment installation diagram showing exposed wiring and piping for model "D" unit with type "B" sub-base.

ITTER MODEL "D" UNIT EQUIPMENT

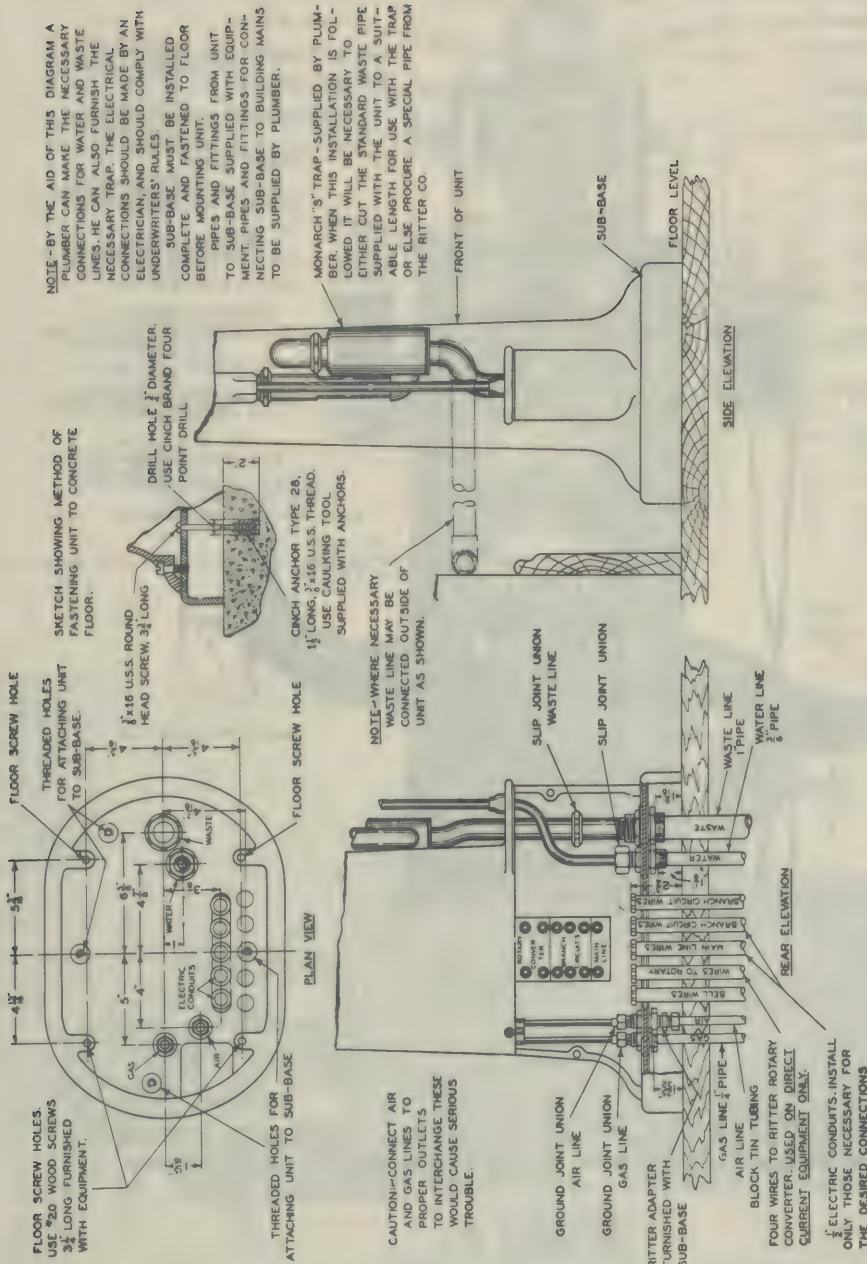


FIGURE NO. 8
Unit equipment installation diagram showing concealed wiring and piping with "monarch" trap for model "D" unit with type "A" sub-base.

ITTER MODEL "D" UNIT EQUIPMENT

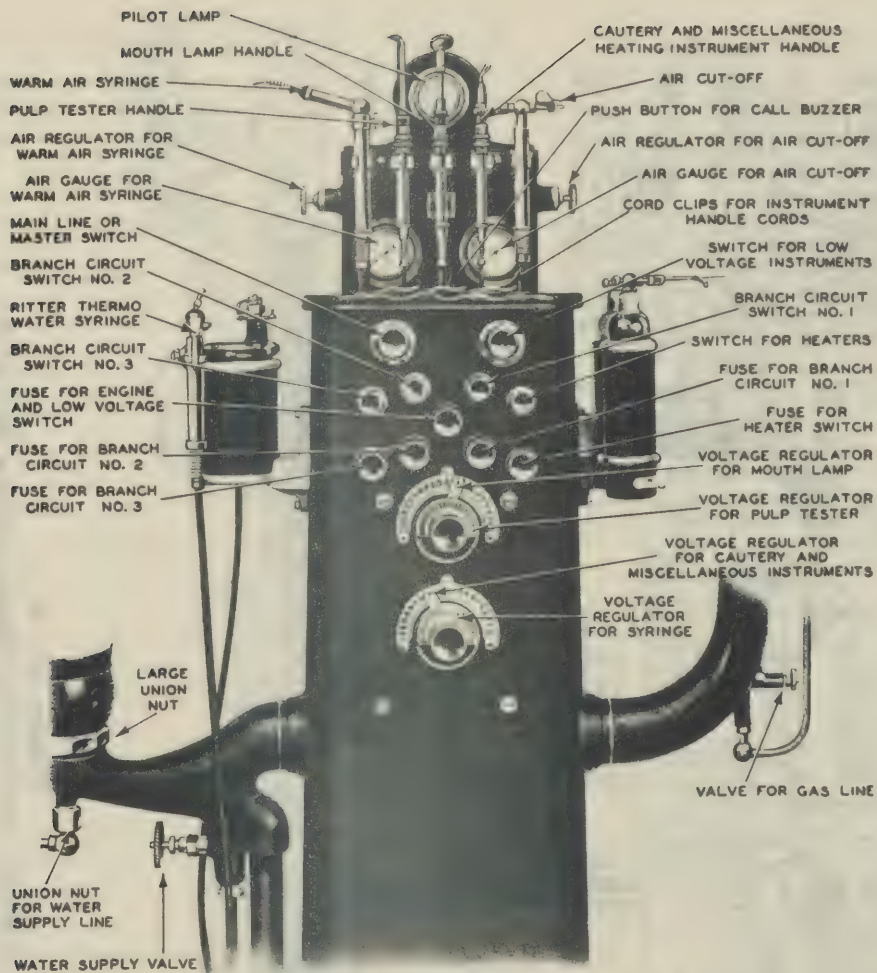


FIGURE NO. 9

CAUTION - Do not operate the warm air syringe without first turning on the air. The heating element is liable to be burned out if heated without air flowing through it.

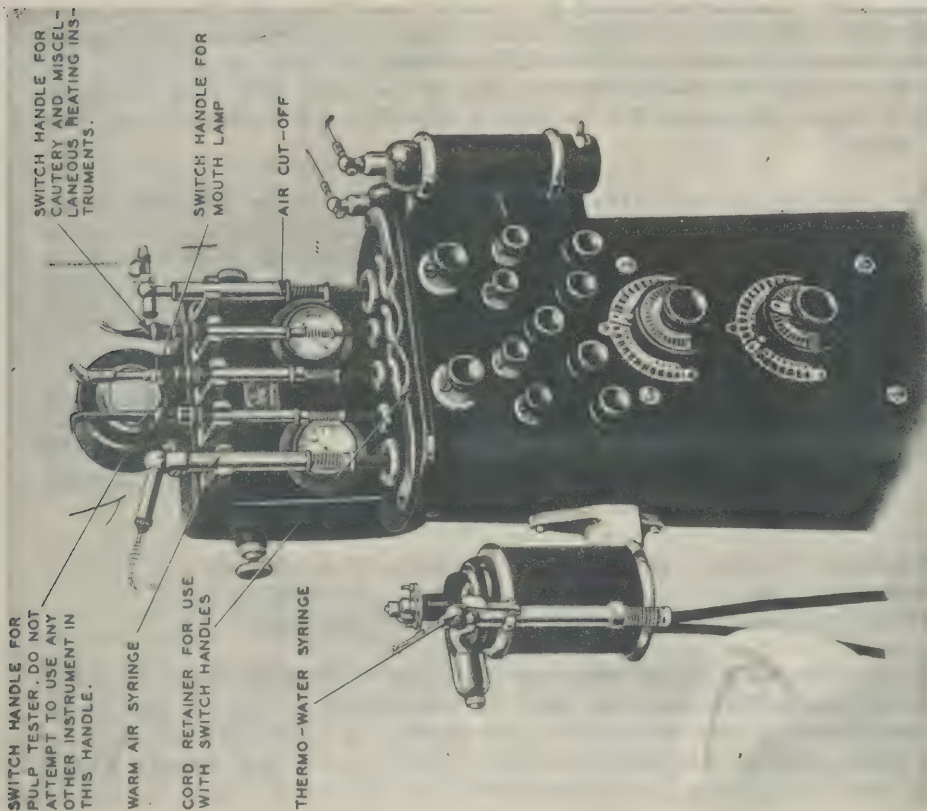


FIGURE NO. 10

Showing the position of the instruments

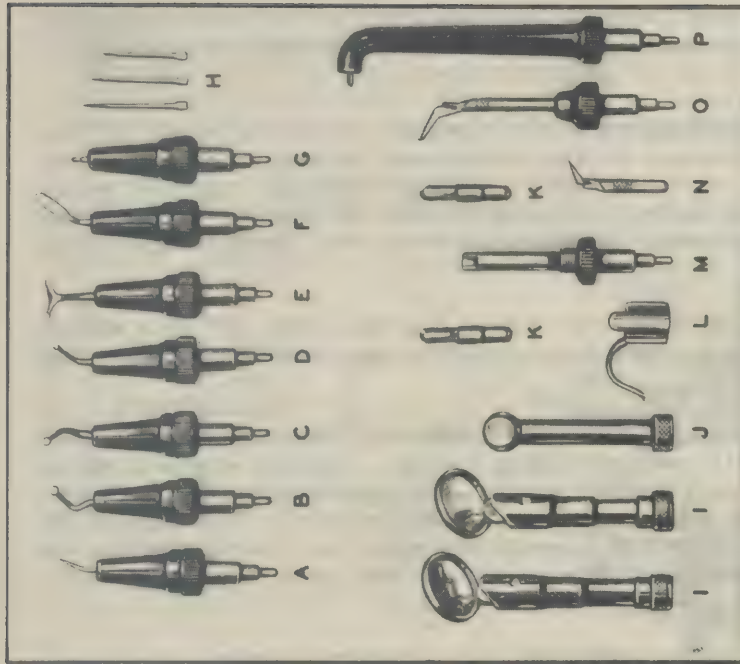


FIGURE NO. 11

RITTER LOW VOLTAGE ELECTRICAL INSTRUMENTS

- | | |
|-------------------------------------|---|
| A. Bleacher Point | J. Transilluminating Shield |
| B. Gutta Percha Excavator (left) | K. Bulbs for Lamp |
| C. Gutta Percha Excavator (right) | L. Supporting Hook for Transilluminating Shield |
| D. Ball Point | M. Lamp Receptacle |
| E. Combination Ball-Wax Spatula | N. T-Head Cautery Tip |
| F. Wax Spatula | O. Cautery Base with Lancet Tip |
| G. Canal Drier Base | P. Two-Point Pulp Tester Electrode |
| H. Tips For Canal Drier | |
| I. Examination Shield, with Mirrors | |

RITTER MODEL "D" UNIT EQUIPMENT

OPERATION

MASTER SWITCH - Looking at the front face of the pedestal, the switch knob at the left top operates the main supply or master switch. When this is pulled out, the current is on all the electrical appliances connected to the Unit, with the exception of the low voltage instruments. The pilot light indicates when the main line switch is "on" or "off."

SWITCH FOR LOW VOLTAGE INSTRUMENTS - This switch is at the right of the "master switch" and controls the current to the transformer or Rotary Converter. All low voltage instruments, such as the pulp tester, warm air syringe, cautery, mouth lamp, etc., are controlled by this switch, which maybe shut off without interfering with the use of the engine, spray bottle heaters, or other full voltage appliances connected to the Unit.

***IMPORTANT** - If the Unit is operated from Direct Current, shut off this switch when the low voltage instruments are not to be used for any length of time. See Rotary Converter directions.*

SWITCHES FOR FULL VOLTAGE APPLIANCES - The remaining switches are for controlling appliances requiring full voltage supply current, such as electric water heater, spray bottle heater, electric fan, engine, air compressor, etc. (Never attach an X-ray or sterilizer, as they require too much current.) The connection plug on the back of pedestal is connected through the main line switch and may be used for any portable full voltage appliance used near the Unit, such as a small fan.

REGULATORS FOR LOW VOLTAGE INSTRUMENTS AND PULP VITALITY TESTER - The regulators which control the current to the pulp vitality tester and the various low voltage instruments are shown in Figure No. 9. On the indicating pointer of each regulator, except the one governing the pulp tester, is a device for locking the regulator in position. After once determining the correct position for the regulator the operator can set this lock if he desires, thus eliminating the possibility of burning out the instruments, due to accidental movement of the regulator. An indicating device is built into the mechanism to clearly indicate each step or point on the regulators, and those operators who so desire may operate without using the locking device provided.

To manipulate the locking devices, lift the small knurled nut on the indicating pointer and turn slightly. This releases the lock and allows the indicator to be moved over the scale plate, the various steps being indicated by the special device provided. To lock these regulators, once the correct position has been ascertained, merely turn the knurled nut until it snaps into place. This causes a small plunger to drop into a hole directly under the desired position number.

The current regulator for the pulp tester is made without the locking device to allow for conveniently progressive increase of current.

The approximate positions, on the regulator scales, at which the various instruments on Ritter Unit Equipment should be used are as follows:

Examination Lamp.....14	Cautery 16 on AC Units
Transilluminating Lamp.....14	" 18 on DC Units
Miscellaneous Instruments...10	Warm Air Syringe....16

Some variation from these figures must be expected. Fluctuations in line voltage, causing a variation in current, may make it desirable to adjust the regulators to different positions. Some operators will prefer to work with an instrument at a different temperature than will others. The figures are merely given

RITTER MODEL "D" UNIT EQUIPMENT

to enable the operator to more readily locate the ordinary position of the regulators.

In adjusting the regulators it is well to start at the first step on the regulator and advance a step at a time until the instrument controlled by the regulator is receiving the proper amount of current, and the desired temperature or brilliancy is attained. The regulators should then be locked, as previously mentioned, and the instruments will always be ready for instant use.

CAUTION - The switch handle in the center is for the lamps only. Do not use it for any of the other instruments. Do not burn the lamps too brightly. Their brilliancy should be determined in the dark, as day light, or any conflicting light, makes it impossible to correctly judge the intensity.

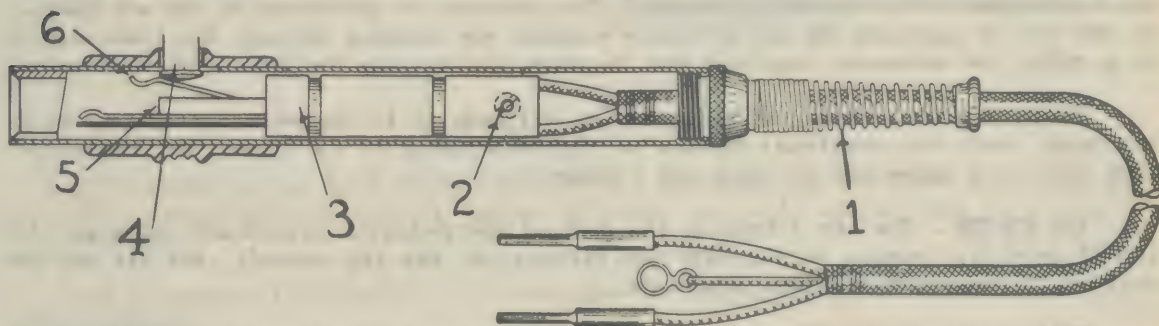


FIGURE NO. 10A

SWITCH HANDLES AND CORDS FOR LOW VOLTAGE INSTRUMENTS - When a low voltage electrical instrument will not function three check-ups are necessary -- namely:

1st - Burned Out Instrument. Check the instrument in another switch handle, setting the low voltage regulator at lowest point and gradually turning it to the highest. If instrument does not respond it is burned out and needs replacement. Should the instrument respond, the trouble then may be one of the following:

2nd - A broken switch handle cord.

Procedure: (See Figure No. 10A.)

This usually occurs at the spring protector (1). Insert into switch an examination or transilluminating lamp which functions. Set the low voltage regulator at the required point for the lamp, being sure to keep the electric current in the switch handle "ON". Unscrew the spring protector (1) from the switch handle cord back and forth with fingers, starting at the switch handle and gradually working down the full length of the cord. An eye must be kept on the lamp so that should it illuminate at any point during the foregoing procedure, you will have located the break in the cord. Usually these breaks in the switch handle cords can temporarily be repaired by cutting out the break and splicing. However, since such a repair is only temporary, a new switch handle cord should be ordered.

3rd - The contact springs in the switch handle may have been bent out of alignment.

Procedure:

Unscrew spring protector (1) from switch handle. Release set screw (2) on switch handle. Pull switch handle cord to which is attached assembled insulator (3) and contact springs from out of switch handle. Care should be exercised not to lose switch button (4). Insert the contact end of the examination lamp into collar (5) of contact springs. Press upper contact spring (6) down as far as it will go and if it does not then make contact with the end of the examination lamp, bend it gently until it does. Do not bend to such an extent that the spring cannot return

RITTER MODEL "D" UNIT EQUIPMENT

to normal position when finger pressure is released. Leave the current on so that proper contact may be determined through the illumination of the examination lamp. Proper procedure for reassembling the switch handle is as follows:

Insert switch button (4) into switch handle, turning the handle so that the button will be on the bottom side. Slide contact springs and assembled insulator into switch handle with the short contact spring downward over switch button (4). Push entire assembly as far forward as it will go into switch handle or until the screw holes for the set screw (2) have been aligned. Reset set screw (2) into switch handle and insulator. Screw spring protector (1) for cord on to switch handle.

AIR CUT-OFF & WARM AIR SYRINGE AIR PRESSURE REGULATORS - Figure No. 9 shows the air regulator and air gauge for the air cut-off & the warm air syringe. Turning the regulator handle to the right increases the air pressure. To decrease the pressure the handle should be turned to the left. The pressure is indicated on the air gauge. Do not try to regulate the air pressure without air passing through the instrument. As a rule, the pressure required for the warm air syringe is from 2 to 10 pounds.

If any trouble occurs, which causes an air leakage in the warm air syringe or in the hose, turn the regulator handle to the left until it is free. The regulator then acts as a valve and prevents the leakage.

AIR FILTER - The air filter on the back of the pedestal has an air valve on it, and if anything happens to the warm air syringe, or the air cut-off, the air may be shut off by means of it. See Figure No. 2.

PULP VITALITY TESTER - The pulp vitality tester electrode is operated in a special switch handle on the Unit. This switch handle is controlled by the regulator marked "Pulp Tester" on the face of the Unit.

MAINTENANCE

FUSES - The Unit is fully equipped with the proper fuses when it leaves the factory and when replacement is necessary the following directions should be observed.

Unscrewing the caps on the fuse receptacles, shown in Figure No. 9, exposes those for the branch circuits. All should be of 5 ampere capacity except on Alternating Current Unit, then the one for branch circuit No. 3, to which the air compressor is connected, should be 15 amperes.

All fuses are a standard 2 inch enclosed type.

AIR CUT-OFF HOSE REPLACEMENT - (See Figure No. 12.) To replace the air cut-off hose, remove the upper back cover of the Unit, exposing the hose connections. Unscrew the union nut on the inside of the Unit, then remove the hose from the weighted pulley and withdraw it through the opening at the top of the Unit.

CAUTION - Avoid dropping the pulley to the base of the Unit when removing the old hose. A good plan to follow is to butt together the ends of the old and new hose, securing them with friction or adhesive tape. The old hose can then be pulled through, bringing the new hose around with it.

The old hose should then be removed from the air cut-off and the new one attached in its place.

RITTER MODEL "D" UNIT EQUIPMENT

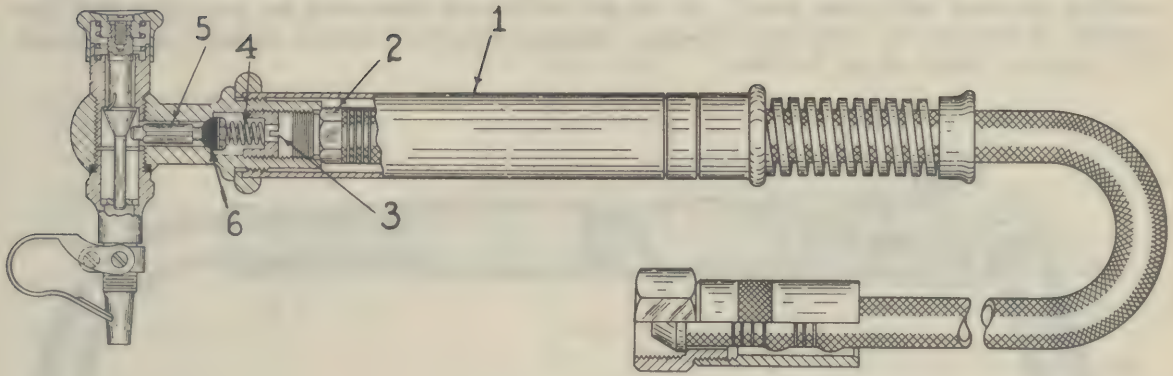


FIGURE NO. 12

AIR CUT-OFF - Air leak from nozzle of air cut-off. (See Figure No. 12.) An air leak at nozzle of cut-off is caused by a worn out valve which must be replaced.
Procedure:

1st - Unscrew the handle (1) of the cut-off and allow it to slide down on the rubber tubing.

2nd - Unscrew the hose tip (2) from cut-off head thus removing hose entirely.

3rd - Unscrew and remove the hollow retaining screw (3) for valve stem.

4th - Remove the valve spring (4) and with it the valve stem (5) to which is assembled the rubber valve (6).

5th - Insert new valve stem assembly (5 and 6) with the old valve spring (4).

6th - Screw back into position, as far as it will go, the hollow retaining screw (3).

7th - Reattach the rubber tubing hose tip (2) to cut-off head, being sure it is screwed up tight.

8th - Screw with hand the handle (1) to cut-off head.

WARM AIR SYRINGE - Check-up procedure when the warm air syringe fails to function. (See Figure No. 12A.)

1st - A burned out or loose heating element (1).

Procedure:

Remove syringe tip by unscrewing tip base (2) from syringe.

Insert small screwdriver into opening of syringe so that it fits into slot of heating element (1), and if it seems loose, tighten it gently and then test syringe by turning on low voltage switch and press on thumb button of syringe, thereby allowing air to escape.

If warm air is not obtained, remove heating element by unscrewing with screwdriver. Insert new heating element and again test. If warm air is obtained, it

RITTER MODEL "D" UNIT EQUIPMENT

proves that the old element is burned out. If warm air is not obtained, change the heating element and then test. If it is still not possible to get warm air the trouble is not in the heating element. Replace the old heating element and proceed with further check up as follows:

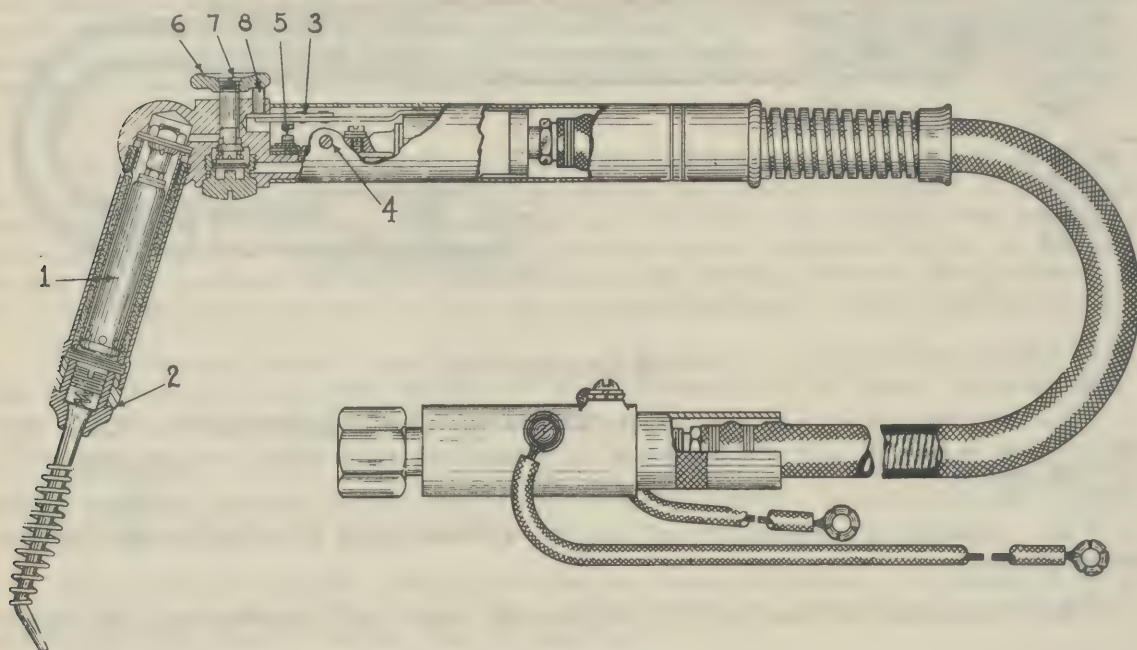


FIGURE NO. 12A

2nd - A bent switch spring (3) preventing contact in syringe handle.

Procedure:

Remove two screws (4), one on each side of syringe handle. Slip handle down thus exposing switch spring and contact (5).

If switch spring is bent, straighten it so that when pressing thumb button (6) proper contact (5) is made. Also check screw (7), being sure that it is tight, so that thumb button is in proper position, thus contacting pin (8) for engaging switch spring assembly thereby assuring proper contact (5) when thumb button is pressed down. Test again for warm air and if none is obtained, it would indicate a broken wire in the syringe tubing.

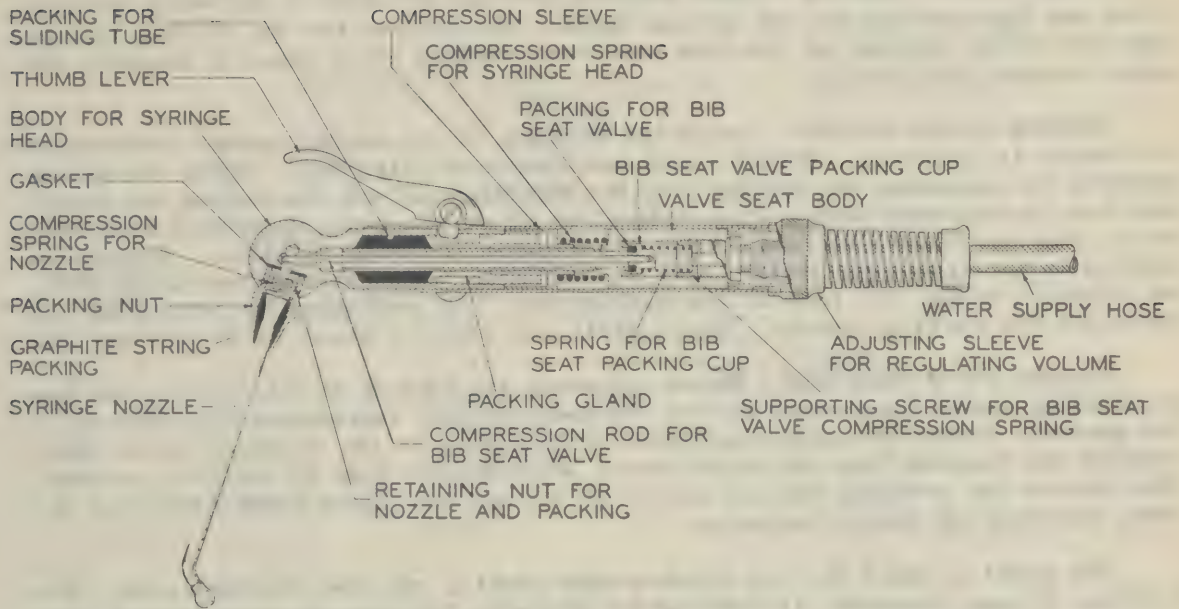
To determine a broken wire in the warm air syringe use a test lamp.

A broken wire in the warm air syringe tubing cannot be repaired, therefore replacement with a new tubing is necessary.

WARM AIR SYRINGE HOSE REPLACEMENT - (See Figure No.12A.) The same procedure which is followed when renewing the air cut-off hose, should be followed when replacing a hose on the warm air syringe. The handle of the warm air syringe, however, is held in place by two small screws which should be removed, after which the handle will slip off.

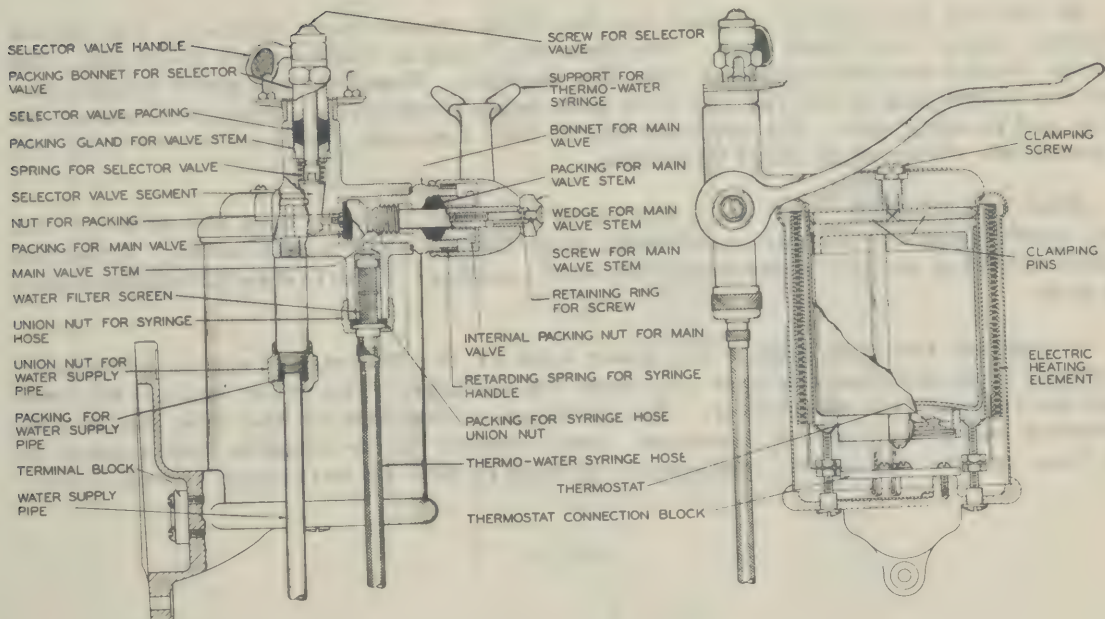
RITTER THERMO-WATER SYRINGE AND HEATER - IMPORTANT - Models A & C syringe handles are not provided with heating elements. Therefore these handles and tubings are not interchangeable with the handle used on the model E unit.

RITTER MODEL "D" UNIT EQUIPMENT



RITTER THERMO-WATER SYRINGE

Figure No. 13



RITTER ELECTRIC WATER HEATER

Figure No. 14

RITTER MODEL "D" UNIT EQUIPMENT

WATER SYRINGE PACKINGS - Three separate packings are used in the water syringe. These are the packings for the syringe nozzle, the packing for the sliding tube in the head of the syringe and the bibb seat valve packing which actually controls the water entering the syringe.

SYRINGE NOZZLE PACKING - Due to the rotating of the syringe nozzle a packing at this point is necessary. Should a leak ever occur at this point, remove the nozzle assembly by unscrewing the packing nut. The retaining nut for the packing and nozzle can then be tightened with a screw driver, or if a new supply of packing is necessary, this nut should be removed and the packing inserted in place. When a new packing is inserted, make certain that the retaining nut is screwed down level with, or slightly below, the face of the packing nut. In replacing the nozzle do not misplace the packing gasket. These parts are plainly shown in Figure No. 13.

PACKING FOR SLIDING TUBE - Enough allowance for take-up on this packing has been provided to enable the packing to last for years without replacement. To take-up on the packing, loosen the adjusting sleeve which regulates the volume of flow. This removes the tension from the thumb lever, which should then be entirely removed. This allows the outside, tubular handle of the syringe to be drawn back over the hose, exposing the syringe mechanism.

The packing gland for the sliding tube packing can then be tightened. New packing, if ever required, is inserted by following the same procedure except that the body for the syringe head must be disassembled from the rest of the mechanism. Refer to Figure No. 13.

BIBB SEAT VALVE PACKING - The take-up on this packing is entirely automatic and the packing can be entirely disregarded unless a leak develops in the syringe and a new packing is required.

To replace the packing, loosen the adjusting sleeve which regulates the volume of water, remove the thumb lever, and drop the tubular handle over the hose. The hose tip should then be unscrewed from the syringe. Then, with a screw driver, unscrew the supporting screw for the bibb seat valve compression spring and remove the spring and packing cup. The old packing is then removed, replaced by the new, and the parts are returned to their positions.

HOSE REPLACEMENT - Two hose are used, one contained within the other. The small inner hose is the one which will most likely need replacement, altho the braided covering of the outer hose may wear, making it desirable to replace this hose also.

To replace the hose remove the outer tube of the thermo-syringe as previously explained, then unscrew the hose tip from the syringe. The other end of the hose should be removed from the heater. The fittings on the ends of the hose should then be removed and placed on the new hose. Make certain to re-assemble these parts as they were on the old hose. Reference to Figure No. 13 will help in this work.

WIRING DIAGRAM OF
MODEL D UNIT 100 TO 250V. ALTERNATING CURRENT

RESISTANCE REQUIRED IF VOLTAGE EXCEEDS 120

CONNECTIONS IF VOLTAGE EXCEEDS 120.

PURPLE
RED
CAUTERY AND MISC. INST.
MOUTH LAMP
PULP TESTER
SYRINGE
YELLOW
GREEN
BLUE
BROWN
BLACK
LOW VOLTAGE SWITCH
GREY
GREEN
BROWN
YELLOW
GREEN
YELLOW
HEATER
HEATER SWITCH
FUSE
FUSE
FUSE
FUSE
FUSE
FUSE
RED
PURPLE
GREEN
BLACK
YELLOW
BLUE
BROWN
RED
TRANS CONNECTIONS
REGULATOR PANEL
ENGINE COLLECTOR ROD
TRANSFORMER PRIMARY LEADS
MISC. INST. AND CAUTERY
LAMP
PULP TESTER
PULP TESTER TRANSFORMER
PLUG RECEPTACLE
RESISTANCE
BLACK
WHITE
BLUE
GREEN
GREEN-YELLOW
GRAY
YELLOW
BROWN
IF ONE SIDE OF CIRCUIT IS GROUND IT MUST BE CONNECTED HERE

ADAPTER CONNECTION BLOCK

7 WIRE CABLE 688 G1

6 WIRE CABLE 688 G3

INSULATING JOINT

ELECTRIC WATER HEATER

MAIN LINE

BRANCH SWITCH

2 BS

BS 3

TRANSFORMER SECONDARY LEADS

PURPLE
WHITE

SECTION LXV

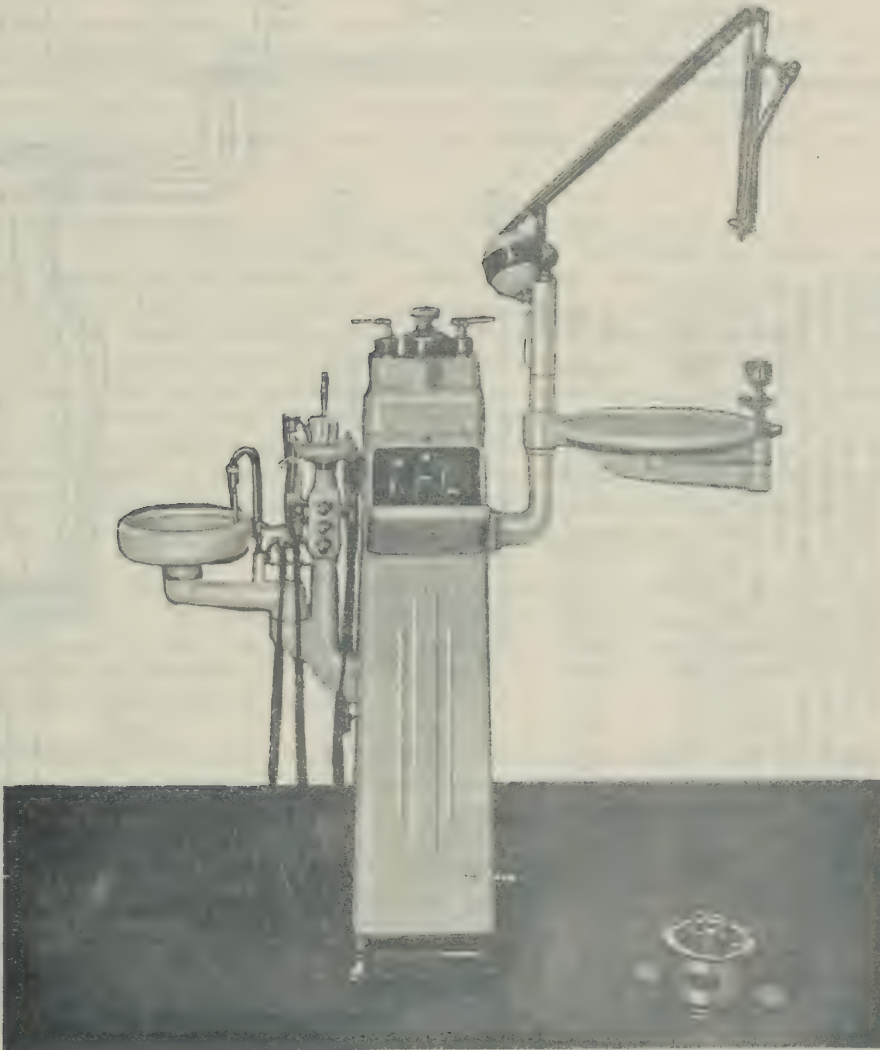
WEBER MODEL F UNIT

**WEBER MODEL "F" UNIT
INSTRUCTIONS FOR UNPACKING AND INSTALLING**

Read carefully before the Unit is removed from the packing case.

Units are shipped with a porcelain finish sub-base securely attached to Unit. This sub-base should not be removed from the Unit body for installation. On the inside of the sub-base is an anchor frame which is bolted to the packing case.

Remove 4 screws, which show on the outside of the porcelain sub-base. Lift Unit and remove from packing case, and remove anchor plate from the packing case to which it is fastened. This anchor plate is screwed to the floor in the position indicated by dotted line on the blueprint, which is furnished for the use of the plumber. The anchor plate must be fastened securely to the floor in a level position. After anchor plate is fastened, set the Unit body to which the sub-base is attached over plumbing, making proper connections with the slip joint fixtures.



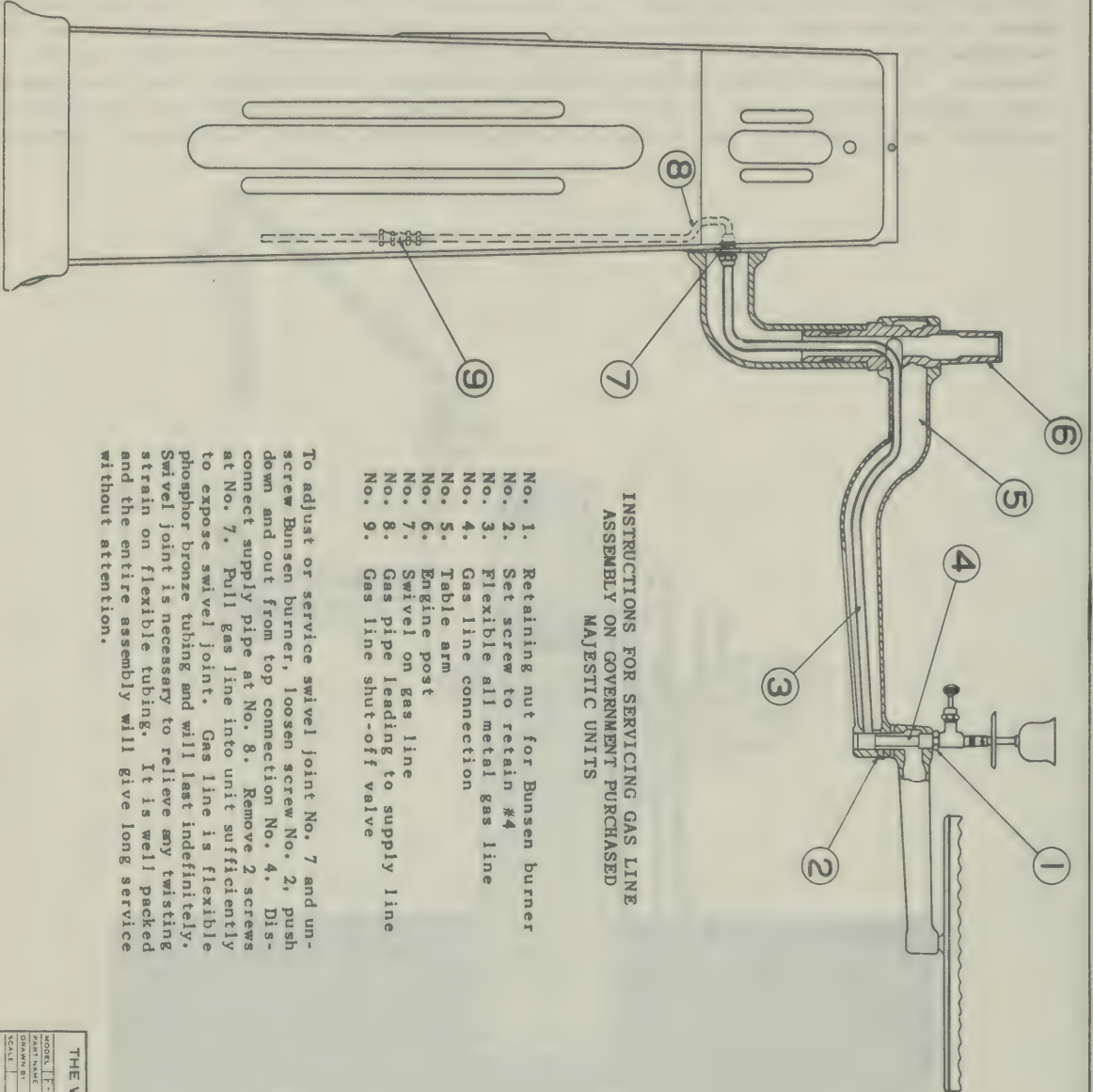
The 4 screws, which hold the sub-base and Unit to anchor plate, are then replaced. All 4 screws should be partly inserted before tightening any one of them, and several turns on each consecutively should be made until the 4 screws are tight. The Unit is now ready for tightening the packing joints.

WEBER MODEL "F" UNIT

FORM F-11

PART NO.

DO NOT SCALE DRAWING. USE DIMENSIONS SHOWN



INSTRUCTIONS FOR SERVICING GAS LINE ASSEMBLY ON GOVERNMENT PURCHASED MAJESTIC UNITS

- No. 1. Retaining nut for Bunsen burner
- No. 2. Set screw to retain #4
- No. 3. Flexible all metal gas line
- No. 4. Gas line connection
- No. 5. Table arm
- No. 6. Engine post
- No. 7. Swivel on gas line
- No. 8. Gas pipe leading to supply line
- No. 9. Gas line shut-off valve

To adjust or service swivel joint No. 7 and unscrew Bunsen burner, loosen screw No. 2, push down and out from top connection No. 4. Disconnect supply pipe at No. 8. Remove 2 screws at No. 7. Pull gas line into unit sufficiently to expose swivel joint. Gas line is flexible phosphor bronze tubing and will last indefinitely. Swivel joint is necessary to relieve any twisting strain on flexible tubing. It is well packed and the entire assembly will give long service without attention.

PART NO.	
MATERIAL REQUIRED	
SIZE	DESCRIPTION

REVISIONS	
NO.	DESCRIPTION
1	
2	
3	

THE WEBER DENTAL MFG. CO.

MADE IN U.S.A.

MODEL F-UNIT FOR GOVERNMENT

PART NAME GAS LINE ASSEMBLY

DRAWN BY JAM

DATE 2-1-39

NO B-441

WEBER MODEL "F" UNIT

The resistance box inside Unit, accessible when the back cover is removed, encloses the distributing panel for engine and serves as a mounting for a transformer. This resistance Unit can be released and will swing away to the outside of the Unit. The temporary removal of this resistance box is advisable to give easy access to bolts, piping, pulleys, or any mechanism which may need attention.

NOTE CAREFULLY - After the screws are removed, wrap a cloth around this resistance unit securing the wrapping with a string so that the resistance panel can hang outside of the Unit body, and will not damage the finish. It will be well to tie this, as a matter of safety, to the table arm.

RETRIEVER CORDS AND TUBING - The retriever pulleys are mounted in a frame and slide on a guide rod. Be sure there is no dirt or foreign substance that will obstruct these pulley weights and prevent free movement.

The lamp switch handle and other instruments, when fully extended, will lock and prevent pulling away of the instrument from the operator when in use. This is accomplished with a spring trigger located at the top of the mouth lamp guide, which will catch when the cord is drawn out to the limit. To release same, pull the mouth lamp cord to its fullest extent, then let go suddenly, and the pulley will release itself.

TABLE ARM (SEE FIGURE NO. 2) - Remove table arm from box. Release screw in bearing of arm No. 5 shown on Figure No. 2. Place table arm on engine post No. 6, remove screw, clamp and set screw No. 2 that hold gas line in place. The wrench for this Allen screw will be found in the accessory kit. Insert gas line and gas line connection No. 4. Push this connection in as far as possible before tightening set screw No. 2. Now replace screw and clamp for holding gas line. The washer tied to the Bunsen burner valve, is to be placed between connection No. 4 and retaining nut No. 1. It is necessary that this washer be placed at this point to prevent gas leakage and also to prevent retaining nut from scraping enamel on short arm. Next fasten retaining nut for Bunsen burner No. 1 to connection. Turn valve control to desired position and lock retaining nut No. 1. If this nut scrapes paint on top of short arm the connection No. 4 is not in its proper position.

AIR FILTER - There is a filter inside the Unit in the air line in which moisture may accumulate. To drain filter and keep it operating, first shut off the air pressure then open a small valve controlled by a finger button and hold a container glass under the discharge to catch the water. This filter can be removed for cleaning by unscrewing one of the heads.

WATER SYRINGE - A pressure regulator is installed in the water line for water syringe and is set at about 25 pounds maximum pressure. This will need no attention unless the operator desires more or less pressure. To increase, turn knob clockwise (right). To decrease, turn knob counter-clockwise (left). This regulator is installed to afford desired pressure regardless of head pressure and controlling pressure to mouth and taking undue pressure from tubing.

The Thermo Water Heater control valve is at the top of heater body. The letter "O" is directly in front when the water is turned off. The letter "W" to the front will cause it to deliver warm water. The letter "C" to the front will cause delivery of cold water. To regulate a mixture of warm and cold water, place between "W" and "C".

SWITCHES AND RHEOSTATS - The line switch controls all current in the Unit "on" or "off" including all appliances, lights, and any other attachments. This switch is at the bottom and center of the control panel.

WEBER MODEL "F" UNIT

The pilot light at the top of panel indicates whether the current is "on" or "off". A second switch is found about the center to right of control panel and is operated by opening and closing the instrument support on Door. When open, the low voltage transformer is connected. When door is closed, low voltage transformer is automatically shut off. The cautery and vitality selector switch is at the top right of panel. It is so marked. This diverts the current either to the cautery or to the vitality tester circuit. The vitality tester and cautery switch handle is the left switch handle on the control panel and has a push button control. This switch handle in the cautery position may be used with a mouth lamp. Volume of current for these respective instruments --- Cautery - is obtained by turning upper low voltage Control knob clockwise from No. 1 to No. 9; Vitality - by turning rheostat clockwise in upper left hand corner. This upper nine-point switch regulates current for either instrument depending on which side the selector switch is on -- cautery or vitality. The low or ninepoint switch regulator controls current to switch handle on panel mounting door which is used for mouth mirror lamp and antrum examining lamp. The air regulators are provided for controlling air pressure to air cut-off and hot air syringe, and are so marked. Turning these regulators to right or clockwise increases air pressure to respective instrument and the reverse lowers pressure.

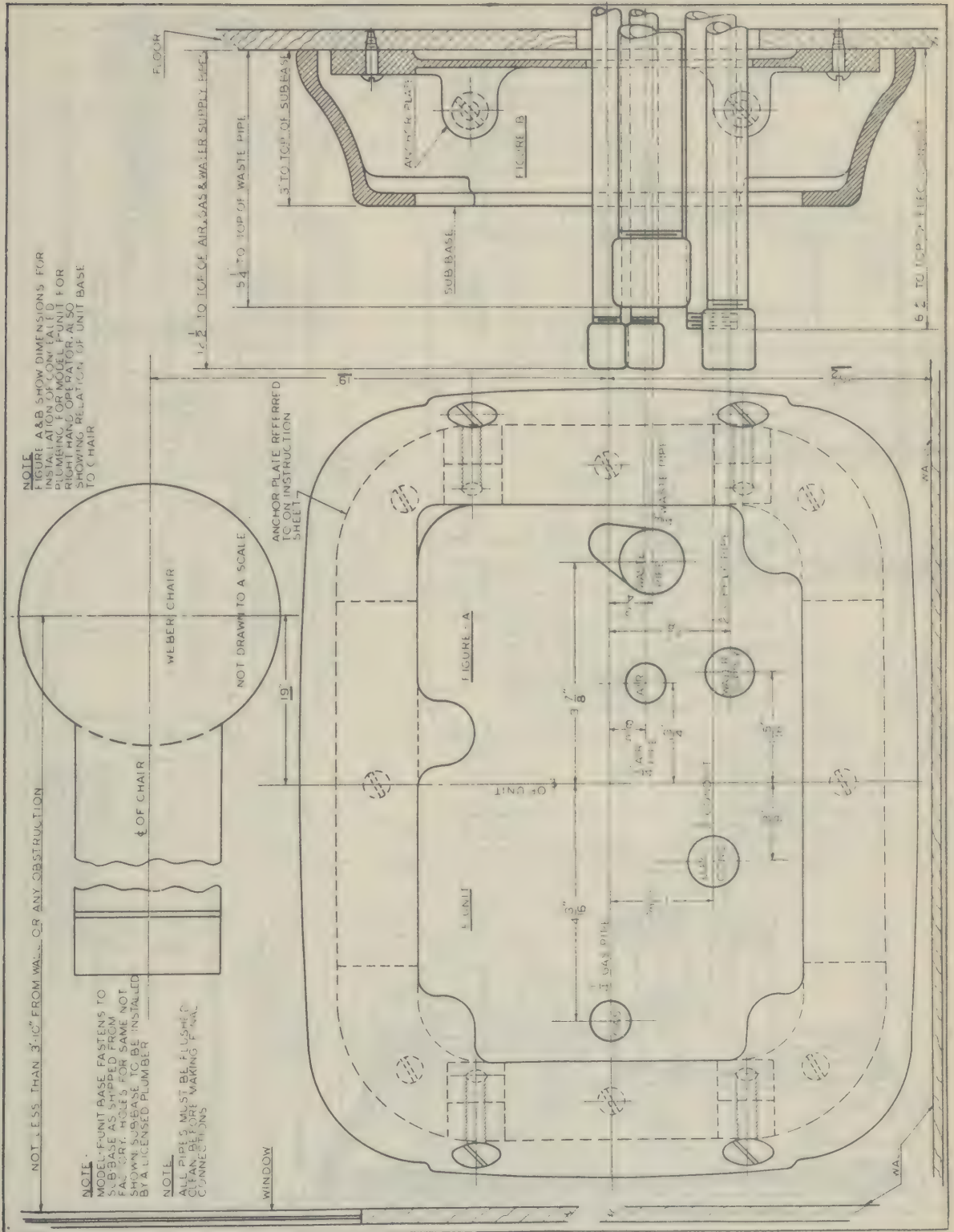
SPRAY HEATER - Looking at the Unit from front, the switch on left of heater body controls current to water heater only, the knob on right side controls current and temperature of spray bottles.

PUSH BUTTON - On right upper side of Unit Pedestal a push button has been provided. This is not wired and to connect same push assembly out from inside. On back of button, necessary wire terminals, are found.

DIRECT CURRENT UNITS - To use these Units on Direct Current a converter is required which is mounted on back of Unit on a special bracket or may be placed at any convenient point in office or Laboratory.

LIGHT ADAPTER - All Units are equipped with light adapters as standard equipment. On right hand hub of light adapters is provided a full voltage outlet for fan or any such appliance.

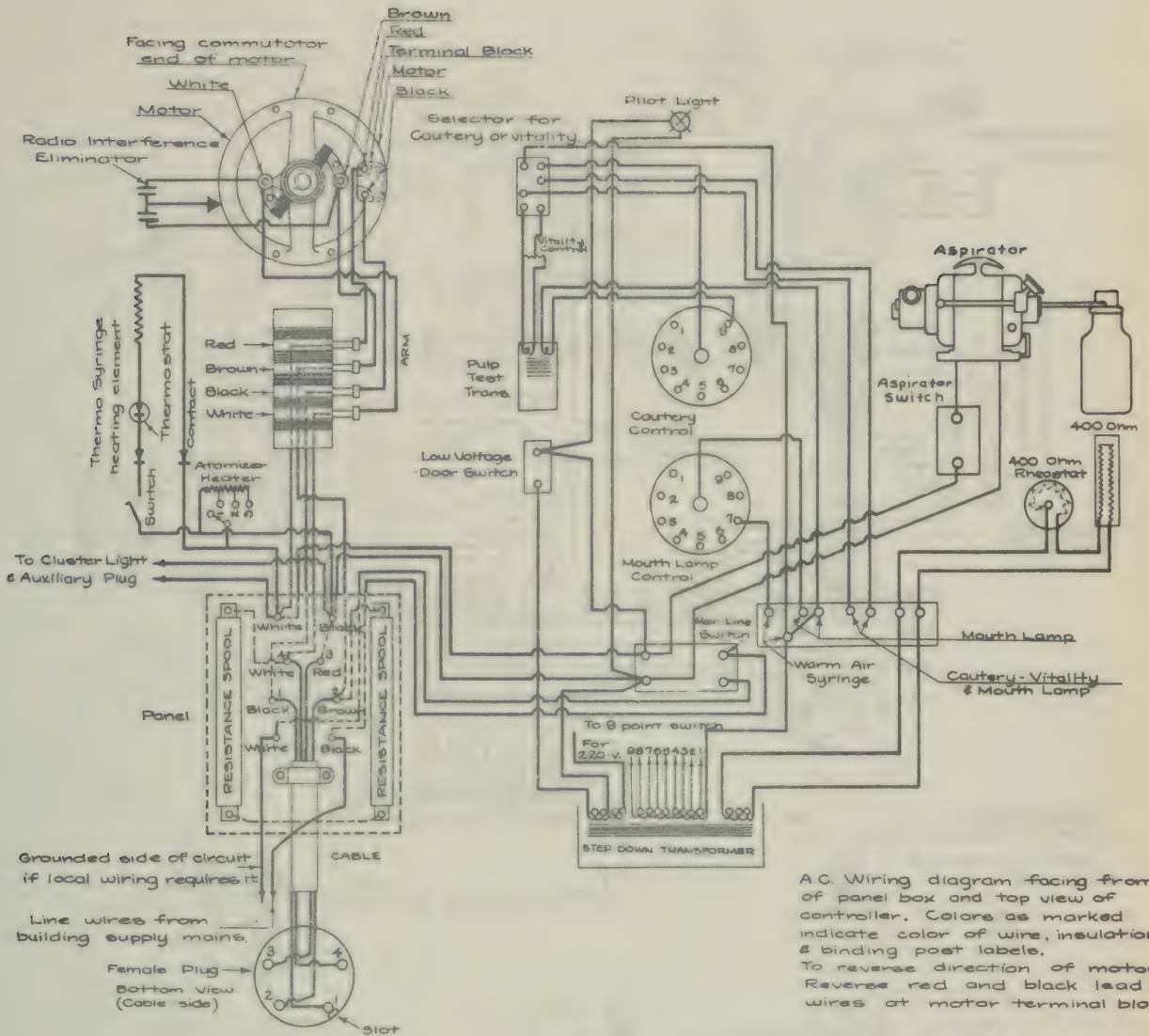
WEBER MODEL "F" UNIT
FLOOR PLAN (CONCEALED)



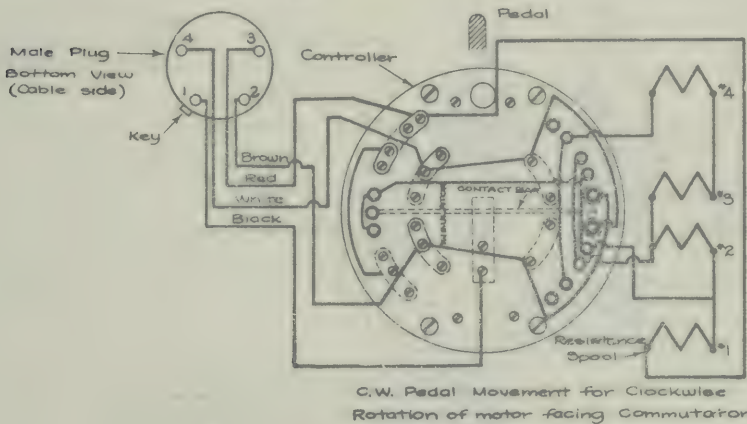
FLOOR PLAN (EXPOSED)



WEBER MODEL "F" UNIT

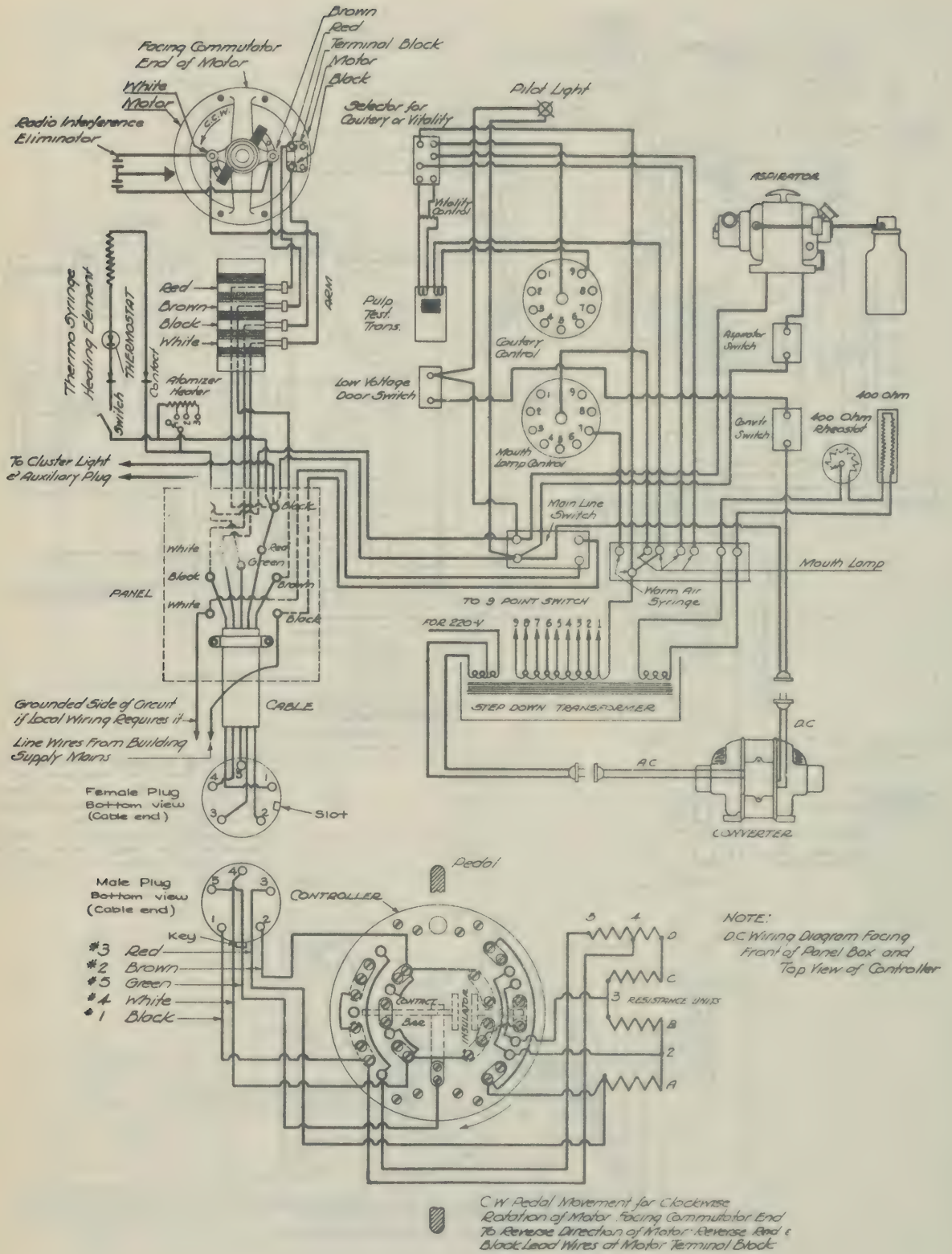


A.C. Wiring diagram facing front of panel box and top view of controller. Colors as marked indicate color of wire, insulation & binding post labels. To reverse direction of motor: Reverse red and black lead wires at motor terminal block



C.W. Pedal Movement for Clockwise Rotation of motor-facing Commutator

WEBER MODEL "F" UNIT



SECTION LXVI

S. S. WHITE MASTER UNIT

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT
(With Plain Table)



Figure 1

INSTALLING AND OPERATING

UNIT BASE - The base illustrated in Figure 3, for through floor plumbing, is supplied with pipe fittings for water supply, waste, gas and air pipes and opening for electrical conduits.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

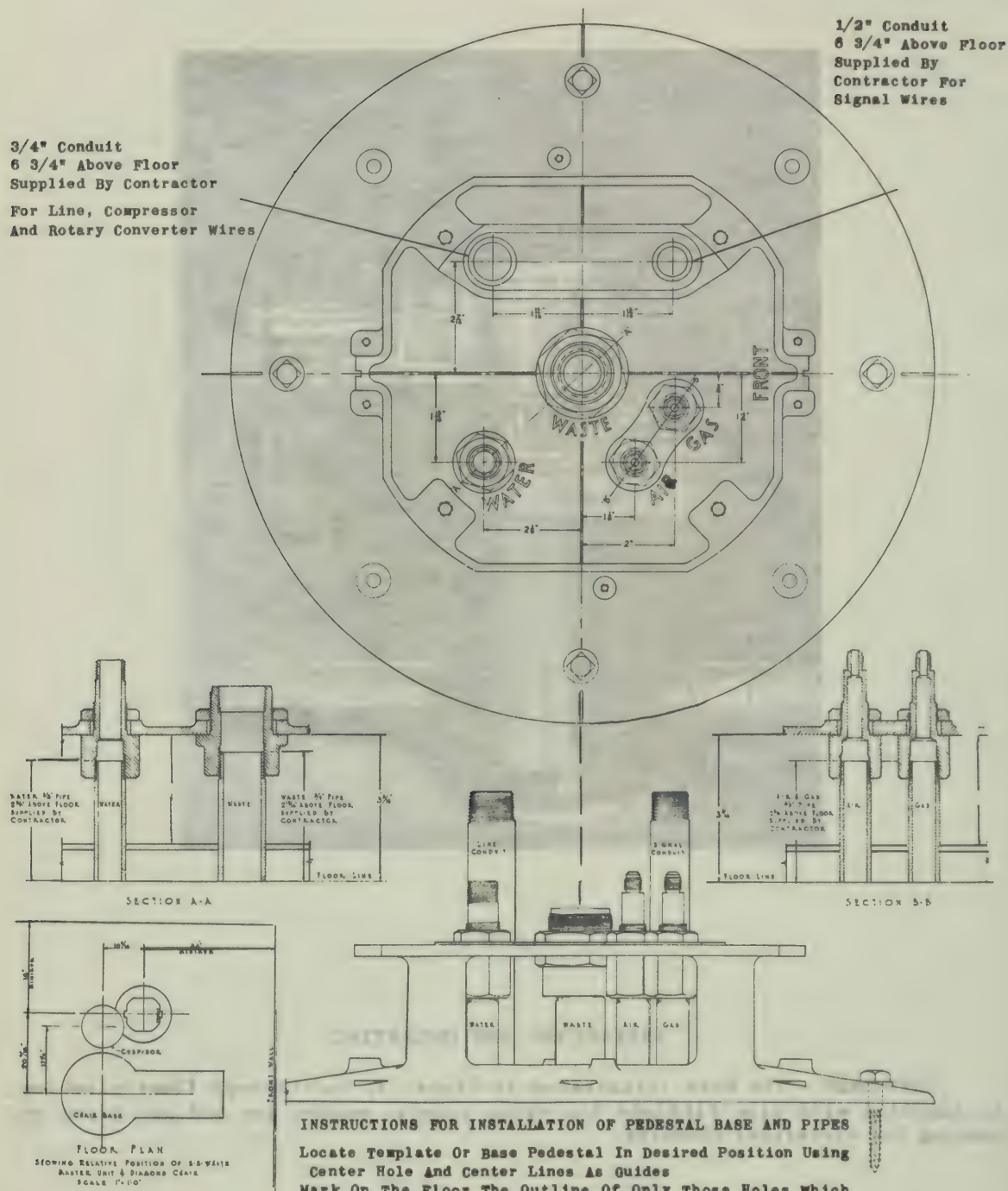


Figure 2
Installation Floor Plan For Master Units

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

SETTING UP - Be sure the unit is adapted to the current to be supplied - the correct voltage if for direct current, or the correct voltage and cycles if for alternating current. See markings on nameplate located on underside of drain below cuspidor.

Remove pipe fittings attached to base.

After locating the position for the unit, install the piping as shown in Figure 2 so that the various pipes line up with their respective openings, then attach base flanged pipe fittings. (See Figure 2 or Figure 3.)

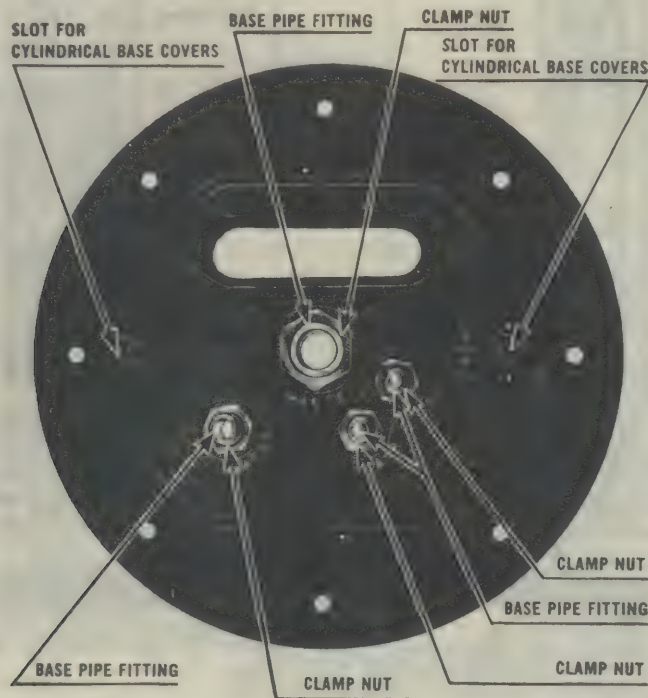


Figure 3
Unit Base with Pipe Fittings - used when
pipes and wires come through the floor.

If unit is to be placed on floor covering, the covering should extend under both the base and base covers so that the same level may be maintained for both.

After the pipes, etc., are installed, lower the base over the pipe connections and fasten the base securely to the floor. Clamp the pipe fittings (see Section A-A and B-B, Figure 2) to the base with their respective clamp nuts.

Connect the water supply, waste, gas and air pipes of the unit to their respective flanged fittings (see Figure 4) and the electrical conduits to their respective openings in pedestal. (See Figure 5.)

For over floor plumbing, a separate installation plan will be supplied.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

GAS AND AIR CONNECTIONS - Union type connections are employed for attaching the gas and air pipes of the unit to the flanged fittings in the base. The seats of all unions must be clean and connections set up tight. Pipes for gas and air are marked on the union nuts on their respective pipes. (See Figure 4.)

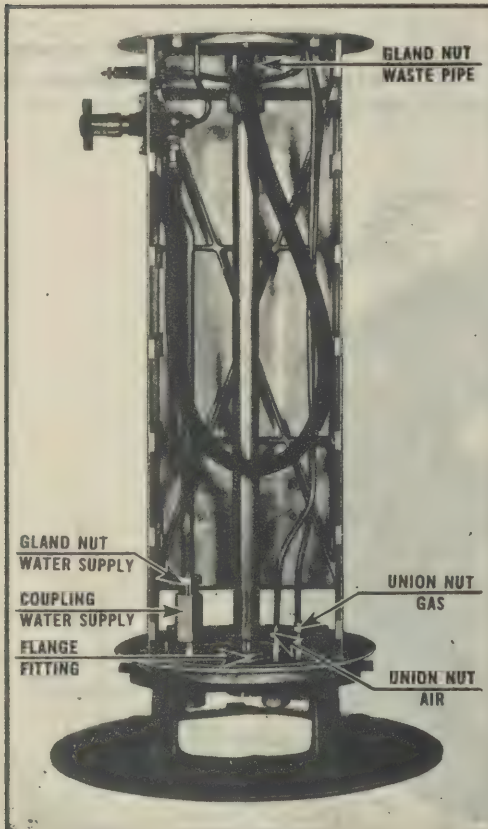


Figure 4
Chair Side of Pedestal
with Cover Removed.

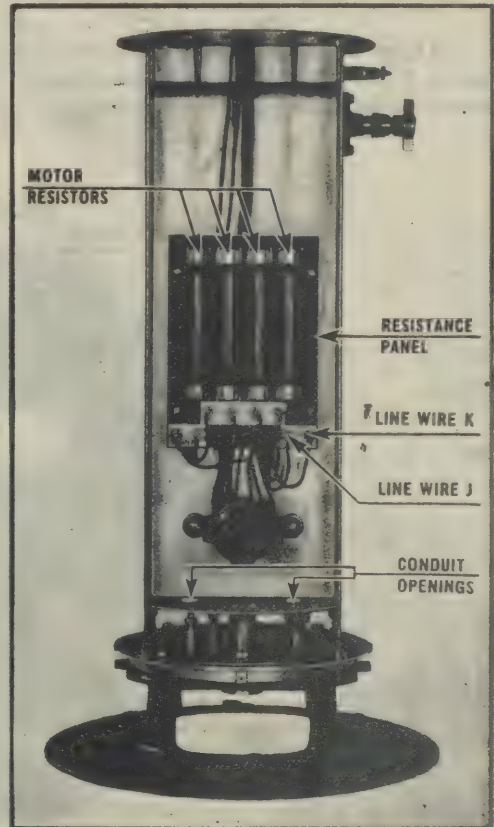


Figure 5
Electrical Side of A. C.
Units with Covers Removed.

WATER - To connect the water supply, slide the coupling down on the pipe and screw it up firmly on the flanged fitting in base. Tighten the gland nut on top of the coupling to prevent leakage of water. (See Figure 4.)

To connect the waste pipe, slide it down and screw it firmly into the flanged fitting in base. The gland nut at top of coupling is correctly adjusted as shipped. Do not tighten, as it may interfere with rotation of cuspidor arm. (See Figure 4.)

ELECTRICITY - Connect the electrical line wires to terminals J and K on the resistance panel. (See Figure 5.)

Signal wires coming into the unit should be connected to the terminals marked "Signal" on the resistance panel. (See Figure 5.)

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

When the main line switch on the unit is to control the air compressor also, the wires to the air compressor should be connected to terminals L and M on the fuse panel in dome section. (See Figure 8.)

ENGINE ARM WITH SUPPORT AND DRIVE PULLEY BEARING - Lower the bearing with engine arm support into the recess in the top of dome section and attach it to the dome section with the two attachment screws provided for this purpose. (See Figure 6.) The flat on flange should face toward the side carrying the fuse panel.

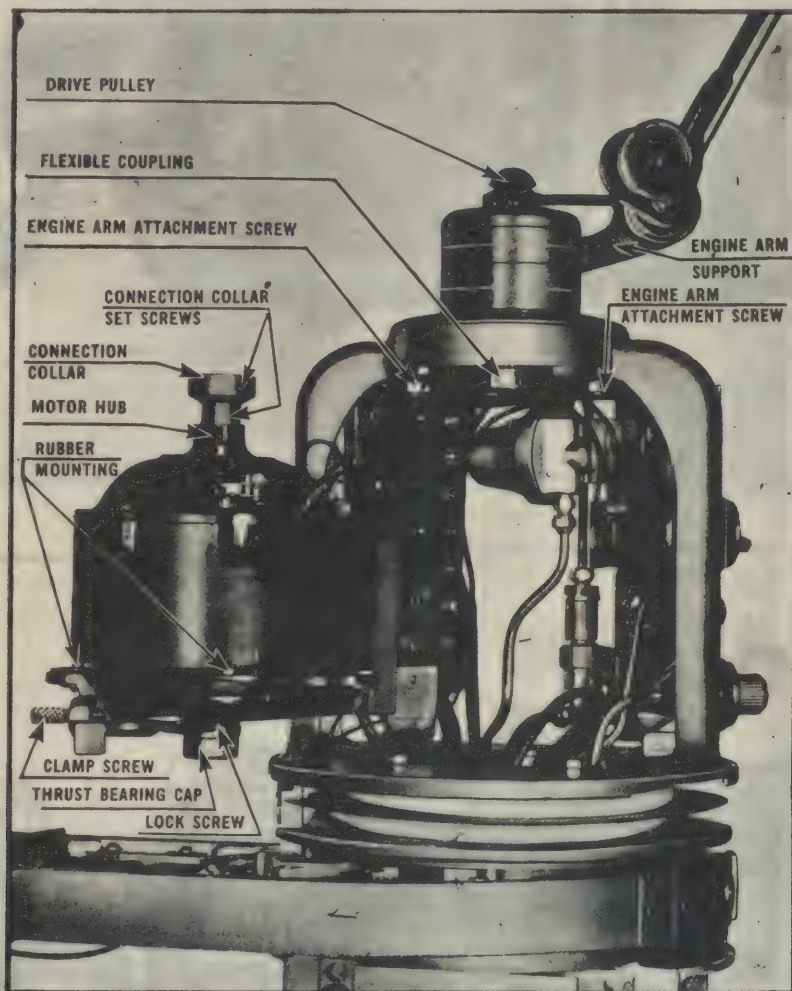


Figure 6
Dome Section showing Motor swung out.

MOTOR - Assemble the motor combination to the dome section. Hinge pins on motor support frame engage in holes in the lugs projecting from side of dome frame. (See Figure 7.) Remove strips of wood under motor which are used for packing purposes and see that motor is free on its rubber mountings. (See Figure 6.) Pass the four lead wires from the motor under the fuse panel and connect to their respective terminals B, C, D, and E on the fuse panel. (See Figure 8.)

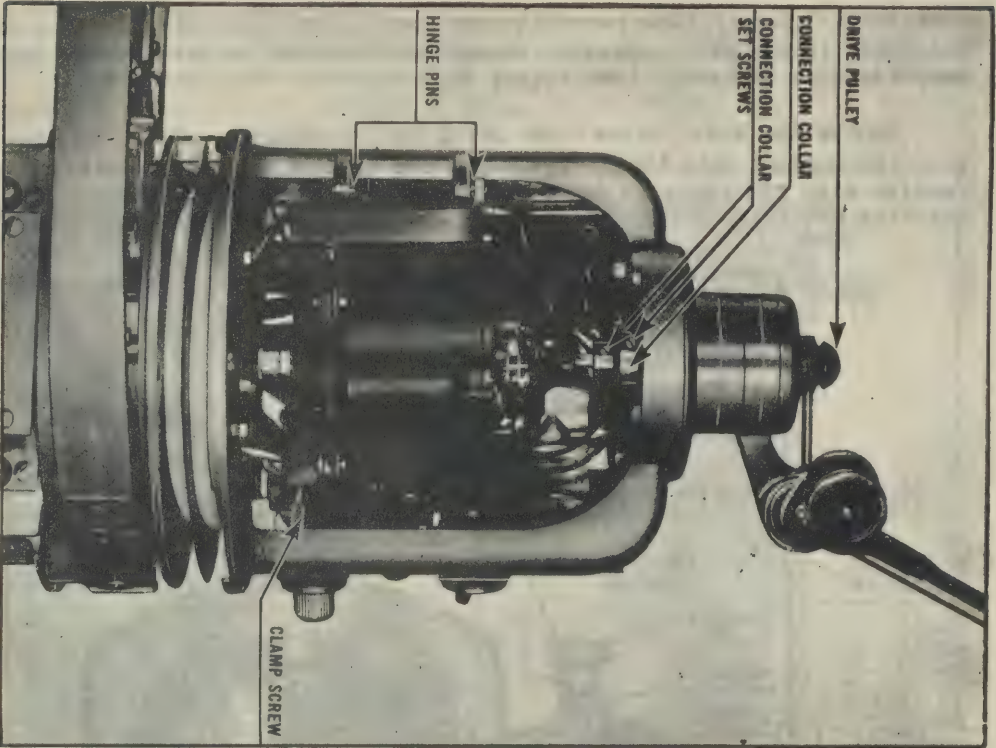


Figure 7
Dome Section showing Motor in place

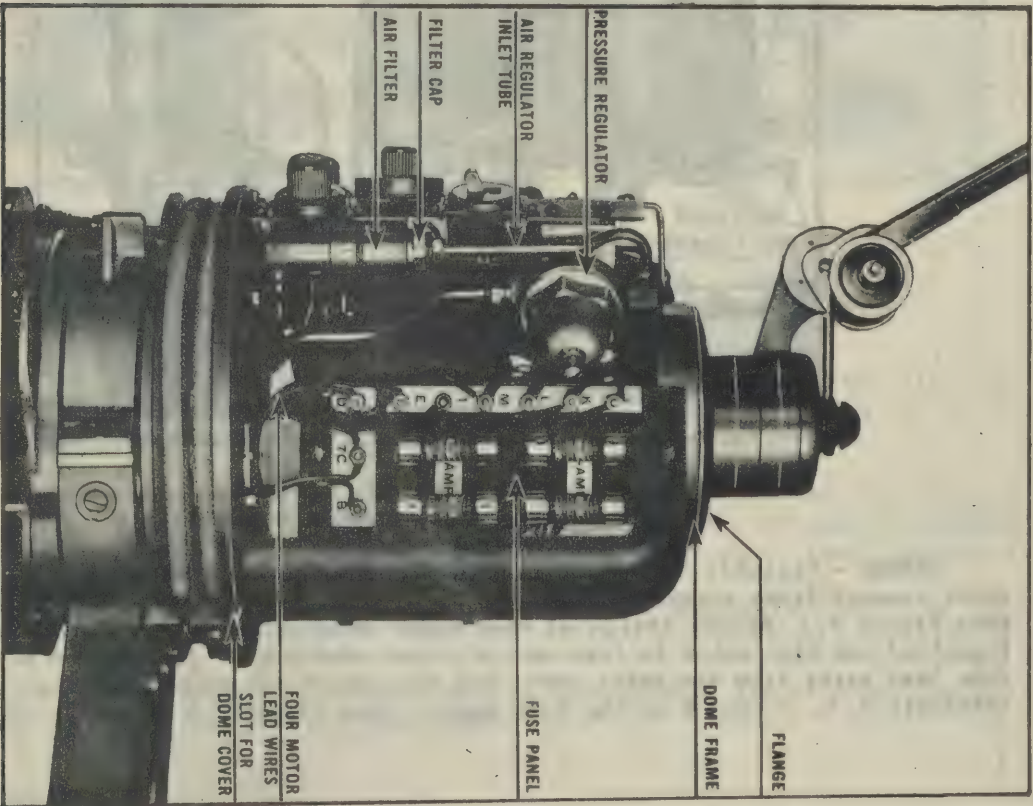


Figure 8
Dome Section showing Fuse Panel

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

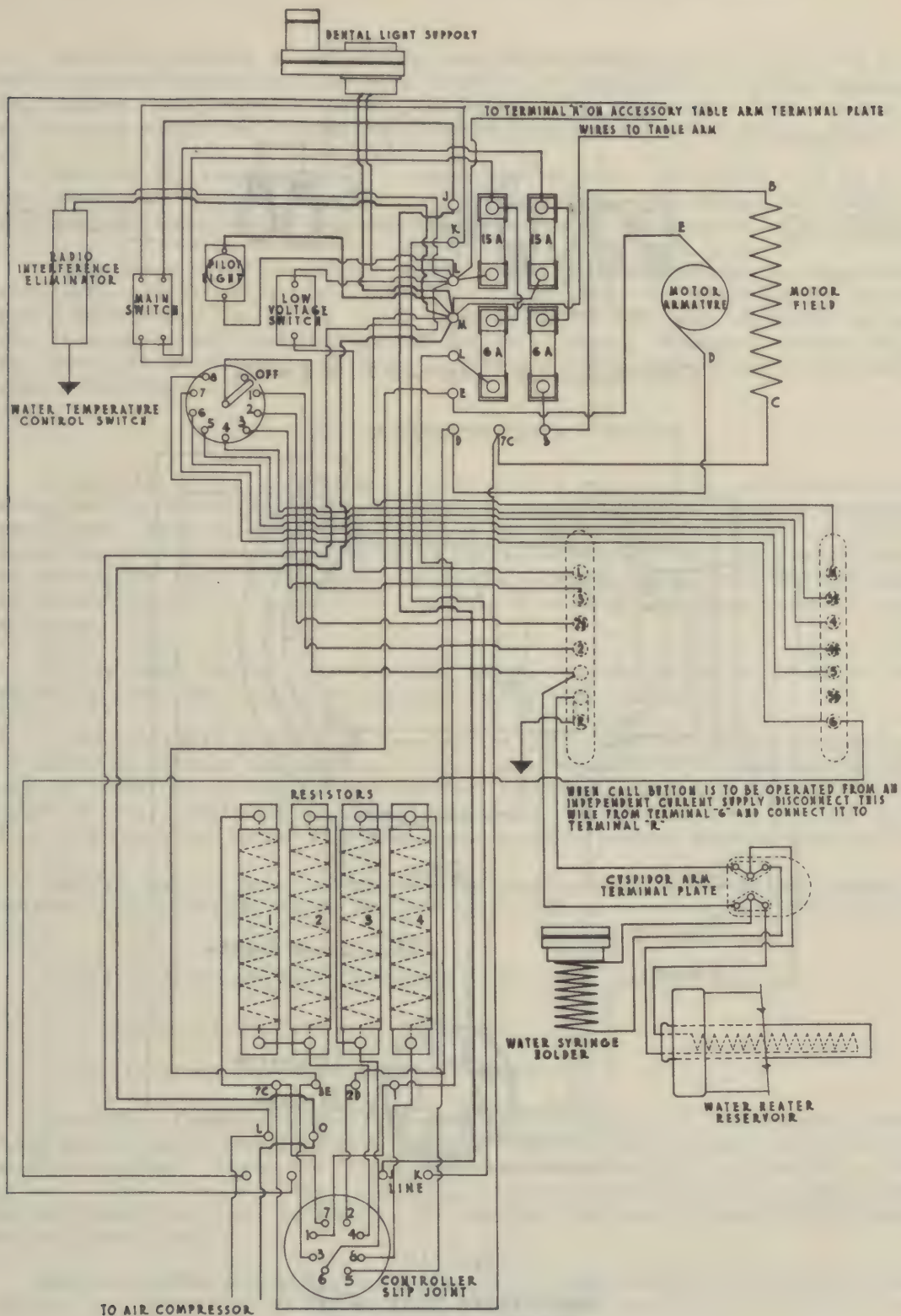


Figure 9
WIRING DIAGRAM (AC)
WITH TRANSFORMER FOR WATER HEATER & ACCESS TABLE

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT



CONTROLLER CONTACT LEVER

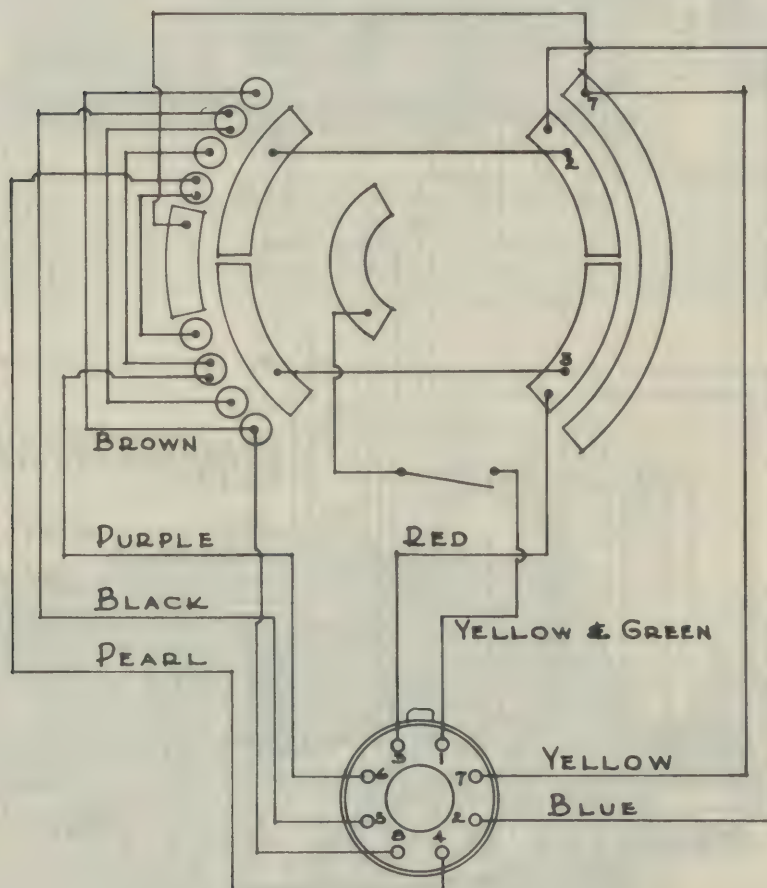


Figure 10

CONTROLLER SLIP JOINT
WIRING DIAGRAM (AC)
FOR MOTOR CONTROLLER

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

Back out the lock screw holding the thrust bearing cap on the under side of motor. Unscrew the cap and put 10 or 12 drops of engine oil in the cap. Replace the cap, tighten firmly both it and the lock screw. (See Figure 6.) Lubricated in this way, bearing should not require reoiling for years under normal running conditions.

Back out the two set screws in connection collar. The collar must be down on motor hub before swinging the motor into dome section. (See Figure 6.) Swing motor into dome section and tighten clamp screw firmly with the fingers. (See Figure 7.)

Slide the connection collar up over the flexible coupling (See Figure 6) on drive pulley shaft and tighten upper set screw. Before tightening the lower set screw, which clamps the collar to the motor shaft, be sure that the collar is in its free floating up and down position on the motor shaft. Rotate the drive pulley a few turns with the fingers, checking for free rotation, then tighten the lower set screw. (See Figure 7.)

ACCESSORY TABLE

Remove the cover on bottom of table arm by removing its attachment screws. Remove the two connecting ring attachment screws on the under side of spray bottle heater arm. Pass the lead wires through the opening in table arm and lower the connecting ring on under side of spray bottle heater arm into the recess in table arm, having the spray bottle heater over the accessory table arm. Attach with the two screws supplied. Connect the lead wires to terminal plate on under side of table arm.

Before lowering table on the arm, remove the two screws with smaller heads projecting above the stop plate attached to the table arm.

Lower the table on the arm, passing the large and small connection plugs and the air hose through the opening on the column side of cross bar and having the front of table facing over the arm handle. Looking down through the opening in the center of table, shift the retaining ring until the attachment screw holes in ring align with the holes in the stop plate, and assemble screws, setting them up firmly.

Connect the air hose to the air line pipe. Plug the electrical connections together underneath the table arm and nest them in recess toward the chair side of arm.

Rotate table to see that it moves freely.

Attach cover to the bottom of table arm.

Place glass table in position.

CUSPIDOR - Cuspidor assembly consists of five pieces: glass bowl, ferrule, rubber gasket and funnel trap (two parts). Lay the rubber gasket in the recess in the drain casting. Screw the ferrule onto the drain casting, one turn only. Place the bowl in the ferrule so that the bayonet indentations in the bowl engage with the lugs on ferrule and turn the bowl by its rim until the bowl is securely held in place. Drop in funnel trap.

SALIVA EJECTOR - Drop the union end of the hose through the hanger on end of cuspidor arm and attach to the threaded nipple under the arm.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

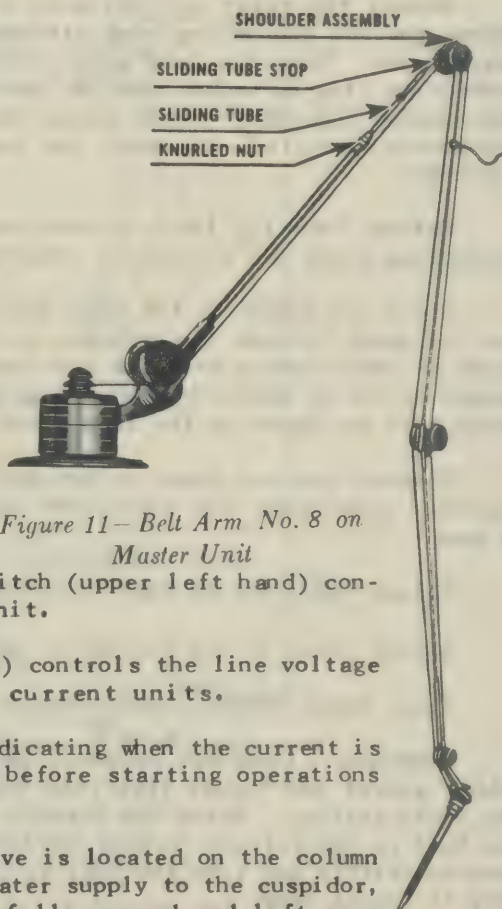
WATER NICHE - Insert drain tube in water niche tumbler basin. Place metal support for tumbler in recess over drain tube, having the projecting lugs up.

With the unit assembled thus far, air, water, gas and electricity may be turned on and connections and operation checked.

COLUMN COVERS - Covers can now be assembled. The base flange covers are attached with three screws in each half. One of the cylindrical base covers is attached by entering one turned-in edge in the slot on one side of base, and springing other edge into slot on opposite side of base. (See Figure 3.) The other covers are assembled in a similar manner. In assembling dome cover that goes over control handles, slide the cover over the various switches and controls and spring into the notches on lower portion of dome section, entering the upper edge between flange and dome frame. (See Figure 8.)

The cover bands can now be assembled in their respective grooves. One attachment screw is used for attaching each band. The slotted end of band should be underneath. The bands should be tight around the covers.

HOW TO PLACE BELT ON ENGINE ARM - It is important that the belt be placed on the pulleys as shown (See Figure 11) otherwise the handpiece will run in the reverse direction when the engine controller lever is moved for the forward direction. When "belting up," let the engine arm hang freely, with the handpiece pointing downward and away from you, then place the belt on the drive pulley and carry it over the other pulleys so that the belt is parallel with the engine arm. The proper belt tension is obtained by loosening the knurled nut on the long arm and pulling out the sliding tube until it is about 3/8" from the stop on the shoulder assembly. Tighten nut.



OPERATION AND GENERAL INFORMATION *Figure 11—Belt Arm No. 8 on Master Unit*

ELECTRIC CURRENT SWITCHES - The main switch (upper left hand) controls the electrical supply for the entire unit.

The low voltage switch (upper right hand) controls the line voltage supply to the transformer on alternating current units.

Both switches are of the tumbler type, indicating when the current is ON or OFF. The current should be turned ON before starting operations and turned OFF before leaving the unit.

WATER SUPPLY - The main water supply valve is located on the column underneath the cuspidor arm. It controls the water supply to the cuspidor, tumbler niche and water syringe. It may be fully opened and left open except when repairs to the above are necessary or it may be turned off before leaving the unit to prevent accidental turning on of the water during absence from the unit.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

The valves controlling the cuspidor flush-bowl, saliva ejector and warm or cold water supply to the water syringe are located on the cuspidor arm.

The filter for water used with the equipment unit is located in the valve block underneath the cuspidor arm. The filter can be removed for cleaning by unscrewing it.

The valve controlling the tumbler supply is located on the column underneath the tumbler niche.

The cuspidor bowl flush valve should be set to allow sufficient water to maintain a constant flushing of the floor of the cuspidor bowl.

Valve controlling the saliva ejector can be adjusted to provide the desired suction.

The function of the by-pass valve for the water syringe is described under the operation of the water syringe.

The cuspidor arm combination can be rotated 90°.

WATER SYRINGE - The water syringe delivers either warm or cold water as desired, and can be operated to deliver from a few drops per minute to a steady stream.

The temperature of the warm water is controlled by the temperature control switch located in the center of the group of control handles in the dome section. Turning it clockwise from the OFF position increases the temperature of the water in the reservoir and also increases the temperature of the heated holder. With normal room temperature and voltages, when the regulator is in position 5, the temperature of the water will be slightly above body temperature. Regulator can be moved to position 8 for quick heating up, but if left in this position the syringe will get too warm to handle and water will be too warm for mouth use.

If cold water is wanted, the by-pass valve on the cuspidor arm should be turned from "warm" to "cold". If cold water is desired over an extended period and the syringe is to be put in its holder between operations, the temperature control switch should be turned to its OFF position.

A valve for completely shutting off the water to the syringe and its reservoir is located underneath the cuspidor arm.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

INSTRUCTIONS FOR S.S. WHITE WARM WATER SYRINGE NO. 3

VALVE ADJUSTMENT - When properly adjusted the valve on the syringe should be set so that the water does not drip from the nozzle. If it is necessary to adjust the valve so that it does not drip: back out the lock screw underneath the control lever and back out the lever adjustment screw on the top of lever. Using the adjusting wrench supplied with the syringe, turn the valve stem adjusting nut counter-clockwise just enough to stop dripping; turn lever adjustment screw on the top of the lever in until there is a slight space between the end of screw and the top of the valve stem; clamp the adjusting screw with the lock screw underneath the lever. In making these adjustments, it would be well to turn the lever stop down far enough so as not to interfere with the adjustment of the lever.

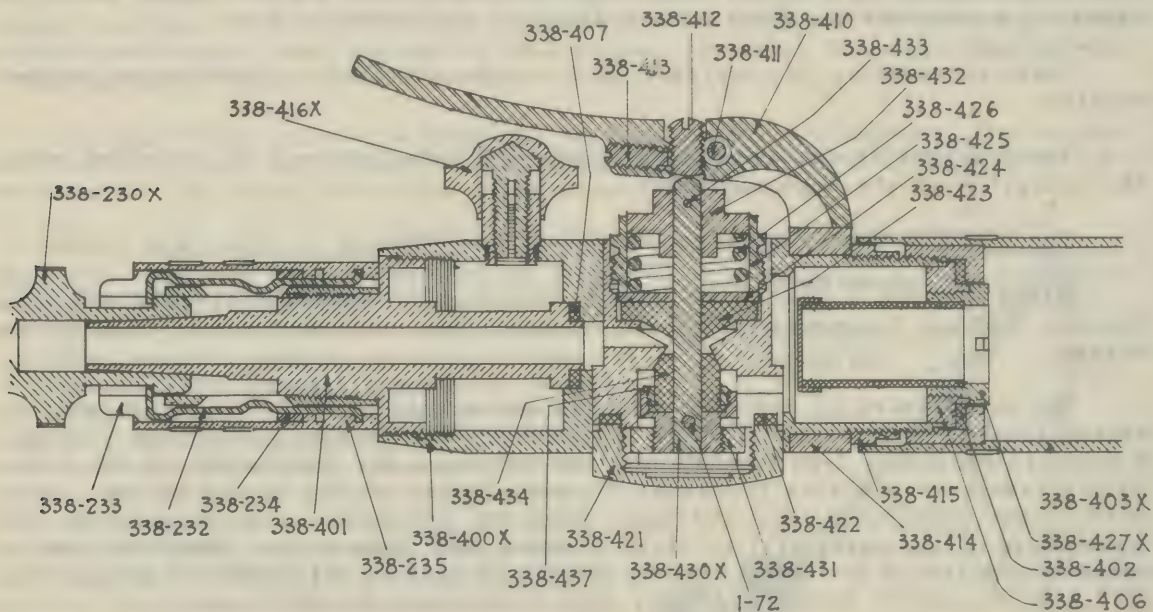


Figure 12

DIRECTIONS FOR REPLACING VALVE PARTS IN WATER SYRINGE NO. 3

After shutting off main water valve on pedestal of Unit, proceed as follows:

1. Remove syringe body by unscrewing from reservoir sheath part 338-403X being careful to retain reservoir sheath gasket part 338-402.
2. Remove lever support clamp nut part 338-415 by unscrewing from syringe body.
3. Remove lever assembly 338-410 by slipping it off the syringe body.
4. Remove valve seat cap part 338-421 by unscrewing.
5. Apply pressure to valve stem adjusting nut part 338-432, then with a pointed instrument force out valve stem key pin part 338-433.
6. Remove valve stem adjusting nut part 338-432 and valve spring part 338-426.
7. Remove valve diaphragm clamp nut part 338-425 by unscrewing.
8. Remove valve stem assembly part 338-430X by applying pressure on upper end of stem, forcing the combination through the bottom of syringe body.
9. Remove the valve diaphragm washer (metal) part 338-424 and the valve diaphragm (rubber) part 338-423.

NOTE: It is advisable at this point to remove, clean and replace the water screen part 338-427X.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

10. Thoroughly clean the valve seats and other interior parts of valve body.
11. Should any deposits be found on the valve stem of combination 338-430X clean them off thoroughly.
12. Remove valve seat washer retaining nut part 338-437 with seat washer (rubber) part 338-434. Separate the parts.
NOTE: For removing part 338-437 a spanner wrench can easily be made by filing a Doriot Handpiece spindle wrench.
13. Assemble a new valve seat washer part 338-434 with part 338-437 and reassemble to valve stem.
14. Place new valve diaphragm (rubber) part 338-423 and valve diaphragm washer part 338-424 in position.
15. Replace and tighten nut part 338-425 (tighten only sufficiently to prevent leakage, slightly more than finger tight).
16. Replace valve stem combination 338-430X by inserting through bottom of valve body and through hole in diaphragm washer part 338-423 and washer part 338-424.
17. Replace valve spring part 338-426.
18. Replace valve stem adjusting nut part 338-432 on valve stem and lock it in place by inserting valve stem key pin part 338-433.
19. Replace valve seat cap part 338-421.
20. Replace lever assembly 338-410 and lever support clamp nut 338-415 tightening it in place.
21. Reassemble syringe body to reservoir sheath end part 338-403X.
22. Back out lever adjusting lock screw part 338-413 and adjust screw part 338-412 until there is a slight clearance between the lever and top of valve stem and tighten lock screw part 338-413.
23. After syringe is connected to water supply and with nozzle part 338-230X in place proper water flow may be obtained by adjusting nut part 338-432.

ADJUSTMENT OF LEVER STOP FOR PRESETTING OF WATER PRESSURE

Should the lever stop part 338-416X turn too freely or not freely enough, adjustment may be made as follows:

1. Apply foregoing instructions through step No. 3.
2. Unscrew and remove lever stop part 338-416X. Adjust split screw on lever stop by spreading or closing to increase or decrease resistance to turning as may be required. To reassemble, reverse the foregoing procedure.

GAS SUPPLY - The main gas valve for the bunsen burner is located in the dome section (lower left). It should be fully opened during operating hours and turned off during absence from unit. At the bunsen burner is a valve for controlling the flame.

The gas burner combination, attached to the under side of table arm, has a pivoted arm carrying the burner and shield normally positioned over the table. The pivoted arm permits removal of the accessory table or table covers without taking off the burner.

AIR SUPPLY - The valve for the air supply for the warm air syringe and cut-off is located in the dome section (lower right). It should be fully opened during operating hours. The air pressure regulator, located in the dome section, is set at 25 lbs. per square in., which pressure is supplied to all air instruments unless the pressure in the supply line is less than 25 lbs. (For further air control see warm air syringe and air cut-off.)

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

The air filter is located in dome section as shown in Figure 8.

The filter pack can be replaced after disconnecting inlet pipe and removing filter cap.

The drain valve for the air filter is located on the outside of the column above the main water supply valve. This valve should always be kept closed except to blow out any water that might accumulate.

TABLE

TABLE ARM - The table arm rotates through an arc--(105°) around the column.

On the rear side of arm, a line voltage outlet is provided so that electrical appliances suitable for locating on table have a convenient connection available.

A handle is provided on the front side of the arm under the accessory table for positioning the arm. Either a push or a pull on this handle permits the arm to be freely swung to the required position. When the handle is not being operated, there is a definite friction against rotation of the arm, thereby preventing the movement of the table when pulling out the instruments and for any other conditions where stability of the table is desired.

TABLE - The warm air syringe, cut-off for spray bottles, are attached to the table.

SPRAY BOTTLE HEATER - The spray bottle heater is mounted on an arm that pivots under the accessory table and can rotate 210° from its normal position over the table arm.

While the main switch is on, the temperature of the liquids in the spray bottles and the tumbler is automatically kept constant by means of a thermostatic control.

With the control lever in *LOW* position, liquids in the bottle and tumbler reach a temperature of approximately 100°F . With the control lever in *HIGH* position, a temperature of approximately 175°F . is obtained. Intermediate temperature can be obtained by putting the control lever in any position between *LOW* and *HIGH*.

WARM AIR SYRINGE - The syringe furnishes a controlled flow of air. It is so constructed that when the low voltage switch is on, a portion of the heating element is in circuit, this heats the inner part of syringe through which the air passes, thereby assuring an immediate flow of warm air at the proper temperature.

The syringe handle should feel warm after the main and low voltage switches have been on for a short time.

The flow of air is controlled by a lever located near the front end of syringe. A rotating sleeve on the forward end of the syringe provides a means of duplicating any particular lever position. This sleeve has five steps on it, permitting a regulation of air flow in five different volumes from that suitable for drying to the full volume obtainable with the syringe. To maintain the air at constant temperature, the lever should be pressed down, causing a secondary electric circuit to be closed. This energizes the balance of the heating element which compensates for the cooling effect of a continued air flow.

The nozzle or metal tip can be rotated around its support and can be removed for sterilization.

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

AIR CUT-OFF - To connect spray bottles to cut-off, see that knurled collar on cut-off is turned to the left. This opens clamping jaws. The spray bottle may then be attached by inserting the nipple connection in the opening of cut-off and clamping by turning knurled collar to the right.

Lever on the side controls the flow of air.

The pressure in the bottle may be regulated by turning the knurled sleeve located under the lever. The volume of air delivered can thus be varied from a small amount to the full volume obtainable at 25 lbs. line pressure.

Cut-off may be left attached while the spray bottle is in the heater.

ELECTRIC ENGINE

MOTOR - Outside of the oiling of the thrust bearing on the lower end of motor as previously described, the motor needs no lubrication.

Heat will develop in all motors when running for long periods of time, but damaging heat will develop only when the motor armature has been running for several hours under abnormal and excessive load. Avoid chances of this trouble by turning off the switch on the column when leaving the unit for a long period.

ENGINE ARM - Aside from occasional cleaning, lubricating and adjusting, the engine arm needs no attention.

INSTRUCTIONS FOR ADJUSTING BELT ARM SUPPORT FRICTION HEAD

Handpiece should be attached when adjusting friction.

Remove pulley on friction head as shown in Figure 13.

TO INCREASE FRICTION - Release set screw No. 512 while holding arm against downward motion.

Place shank of bur in one of the four holes in adjusting nut No. 509 such as "C". Raise arm until surface "E" contacts the bur. A slight additional upward movement rotates the adjusting nut No. 509 increasing the friction. Before releasing pressure against bur, tighten set screw No. 512.

TO DECREASE FRICTION - Place shank of bur in one of the four holes in adjusting nut No. 509 such as "B" and lower arm until surface "D" contacts bur. While still holding arm from further downward motion, release set screw No. 512.

Rotate the adjusting nut No. 509 slightly by a downward motion of the arm. Tighten set screw No. 512.

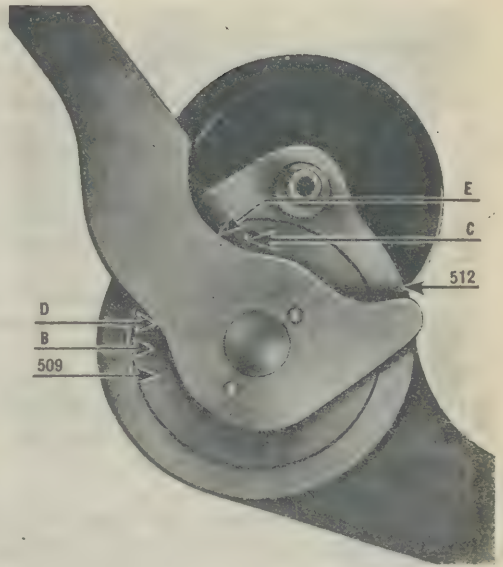


Figure 13—Belt Arm Support Friction Head

INSTALLATION AND OPERATION OF S.S. WHITE MASTER UNIT

MOTOR CONTROLLER

STARTING - See that the controller is conveniently placed for operation and that the controller cable is free from twists and kinks.

Turn the current "on" at the main switch in dome section.

CONTROLLER - This controller embodies two distinct types of control, free return (or automatic) and detent lever (or ratchet).

In the former or automatic type the lever to start and control the speeds of the motor must be held to the desired position by the foot.

In the latter, or detent type, the control lever can be moved four positions forward and four backward. It will remain in position until released by throwing it back or by pressing down on the checkered head of the plunger on the top of the controller.

To change from one type of control to the other, simply throw the movable bail to the opposite side of the plunger head.

CAUTION - Always turn the switch to the "OFF" position when leaving the unit. Before removing any column covers or foot controller turn the switch to "OFF" position. This is to avoid the possibility of an accidental short circuit.

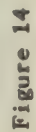




Figure 15

DIRECTIONS FOR CORRECTING FALSE START ON NO. 21 MOTOR

Remove end cover from Motor. Loosen nuts marked "A" and move the brush holder a short distance in the direction of the false start and retighten the nuts. Check for false start before placing cover on Unit.

In making the above adjustments, care must be taken that the brushes are not hit. Otherwise it will be necessary to run the brushes to a full bearing before the Motor can be satisfactorily adjusted for false start.

SECTION LXVII

DENTAL UNITS - SERVICE MODELS

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DENTAL UNITS - SERVICE MODELS

RITTER - Also known as a "Trident Model 'B'" is indicated on the name plate. Serial number of these will always be followed by the letter "s" (indicative of "service" model).

All subjects not covered in the following text will be assumed to be identical to the models "D" and "E" Units.

This Unit is identified by the lack of low voltage switch handles for lamps, cauteries and vitality test. A different pedestal is used approximately two thirds the dimensions of the "E" Unit; otherwise the component parts are interchangeable and common.

WEBER - The Service Model Weber Unit is a modification of the Model "F", in which low voltage switch handles and instruments for use therein are omitted.

S.S. WHITE - The Service Model White Unit is a modification of the "Master" Unit Model, in which the air cut off and warm air syringe are suspended from a simple table. Other table instruments are omitted completely.

GENERAL INFORMATION

In all of these Units a simple bell type transformer is employed to produce a constant low voltage for use of the warm air syringe.

RITTER INSTALLATION

SUPPLY WIRE CONNECTIONS - After all the water, gas and air connections are completed, the electrical connections should be made to the connection block as indicated by directions on the block and shown in Figure 2.

It is necessary to place 15 ampere fuses in the main supply circuit since no provision is made in the Unit equipment for fuses.

The name plate on the back of the pedestal near the top indicates the kind of current for which the Unit is intended. Make sure the current is the same, then proceed to make the necessary connections, using No. 14 rubber covered wires.

CUSPIDOR - Tumbler glass shield is not provided on this Model.

MOUNTING BRACKET TABLE ARMS AND ENGINE - The stop screw provided in the side of the supporting post for the engine must be removed before the bracket table arms can be mounted.

Coat the supporting post with vaseline and mount the bracket table arms. Reassemble the stop screw in the supporting post, tightening it securely.

Mount the engine on the post, properly positioning the keyway in the yoke support relative to the stop screw in the post, and at the same time draw the four engine connecting wires down into the pedestal by means of the heavy cord provided in the supporting arm for the purpose. Each wire is identified by a number stamped on the eyelet and must be attached, with the controller connecting wires, to the connection block terminal having a corresponding number. See Figure No. 2.

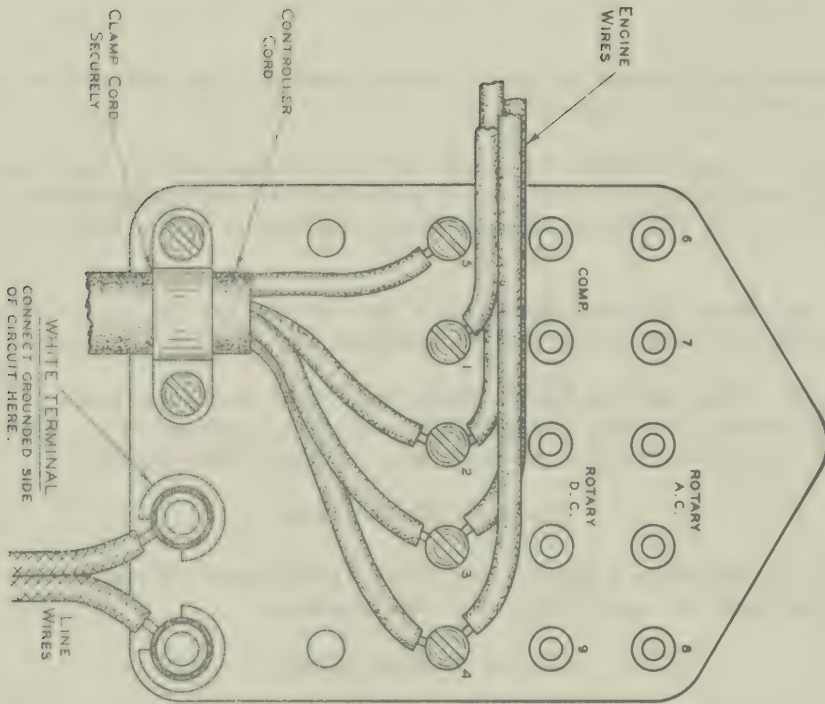


FIGURE NO. 2.

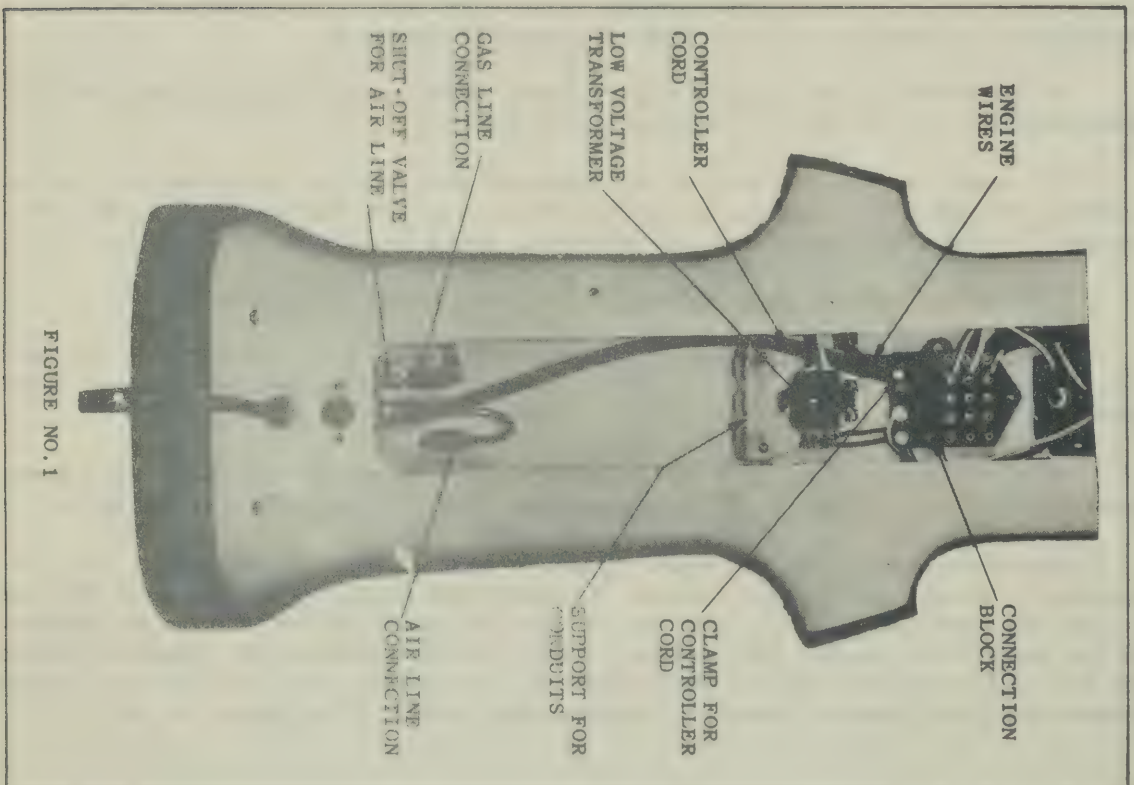


FIGURE NO. 1

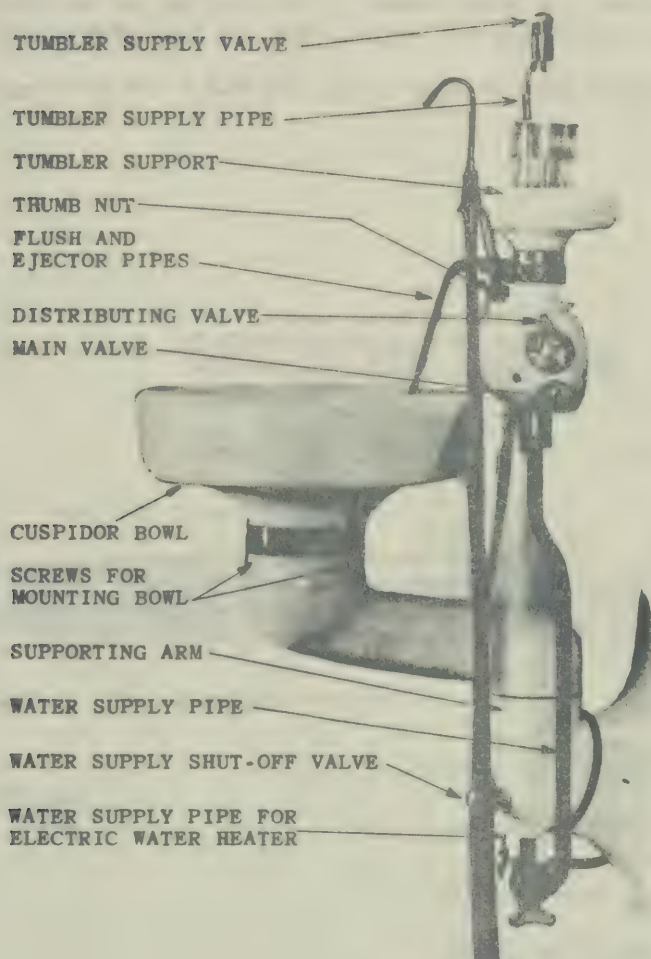


FIGURE NO. 3.

MAINTENANCE

HOSE REPLACEMENT - To replace the warm air syringe hose, remove the wires leading to the insulating joint, on the front of the Unit pedestal, then unscrew the union nut on the upper end of the insulating joint, after which the hose protecting sleeve and hose should be removed from the lower end of the insulating joint. Unscrew the hose protecting spring from the handle and, gripping it with the hand, draw the hose out until the hexagonal tip is exposed. Remove the old hose and assemble the new one, being sure the hose tip is tight against the connection terminal and that the screw, which holds the wire, does not touch the valve body.

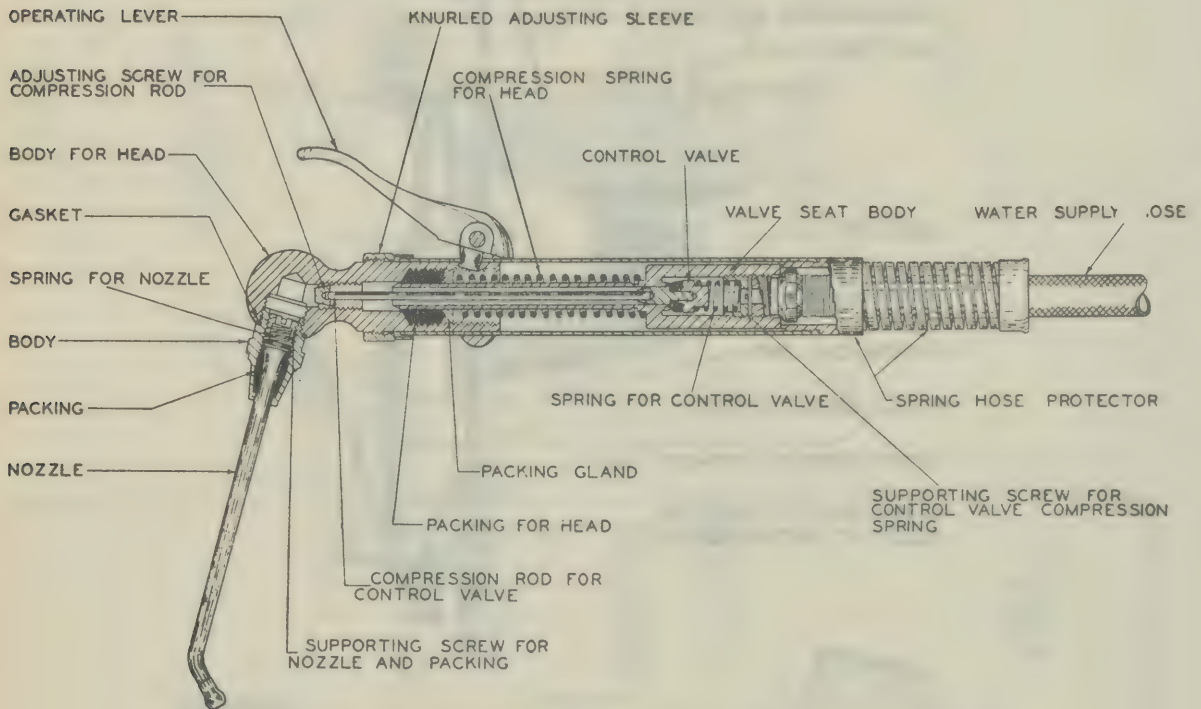
THERMO-SYRINGE AND ELECTRIC WATER HEATER - Syringe is identical to the syringe used on the Model "D" Unit except that the pressure adjustment is located at the hose end of the handle. This is clearly shown in Figure 4.

Unlike the Model "E" Unit syringe there is no heating element in the handle of

DENTAL UNITS - SERVICE MODELS

the Service Unit syringe. In this respect it is similar to the Model "D" Unit, but the majority of parts, including the tubing, are not interchangeable.

Maintenance problems and procedures for the Model "D" Unit syringe will generally apply.



THERMO SYRINGE

FIGURE No. 4

SECTION LXVIII

RITTER AIR COMPRESSOR

INSTALLATION, OPERATION AND MAINTENANCE OF THE RITTER AIR COMPRESSOR

The complete compressor outfit is packed in one box, divided into two compartments, one containing the pump, automatic switch and motor all fastened together, the other the air tank with cover for compressor. Fittings and small parts will be found inside of cover. Always examine excelsior packing carefully to avoid loss of small packages.

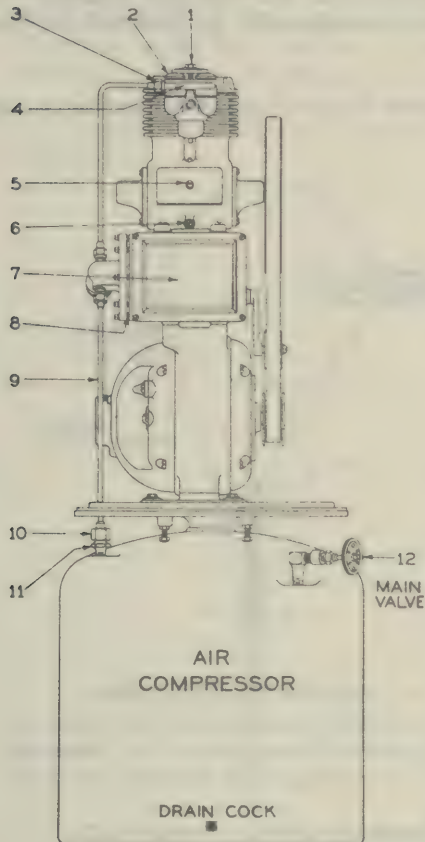


FIGURE No. 1

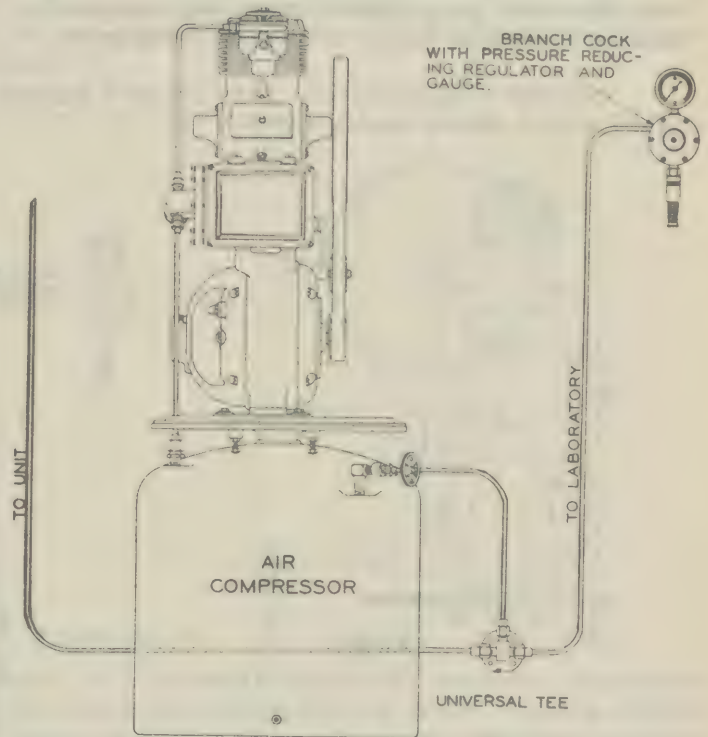


FIGURE No. 2

Showing air outlets at Unit and Valve in laboratory, with the compressor unit connected to pipe line at an intermediate point. This plan will allow placing of the compressor in the laboratory, operating room or any convenient place.

TO ASSEMBLE - Mount Motor and pump on top of tank, setting them in position so the air pipe connections can be made to tank, as shown in Figure No. 1. Fasten motor base to tank plate by means of four screws furnished, then make air pipe connections as explained in following paragraph.

AIR PIPE CONNECTIONS ON PUMP - Connect the two air pipes between pump and automatic switch and between automatic switch and air tank as shown in Figure No. 1. These pipes are of different lengths. The shorter one must connect between pump and switch and the longer between switch and tank. No packing washers are necessary to make these joints air tight. To test for leaks, apply a few drops of oil to joints. A leak will be indicated by the formation of small bubbles or air bells.

AIR LINE CONNECTION - To main air valve No. 12, Figure No. 1, connect pipe leading from air tank to Unit by means of the metal to metal union coupling furnished with the compressor. This coupling must be soldered, with soft solder, to end of tin or copper tubing.

RITTER AIR COMPRESSOR

Several plans may be followed in running the piping from compressor, depending on where the latter is located in relation to the Unit and Compressor Location (usually in laboratory.) Two diagrams are shown in Figures No. 2 and No. 3.

ELECTRICAL CONNECTIONS - Connect the wires, leading from the current supply, to the connection plug found in the plug receptacle. This receptacle is located in the back of automatic switch box No. 7, diagram No. 1.

CAUTION - Make certain that current agrees with data stamped on motor name plate before making connections.

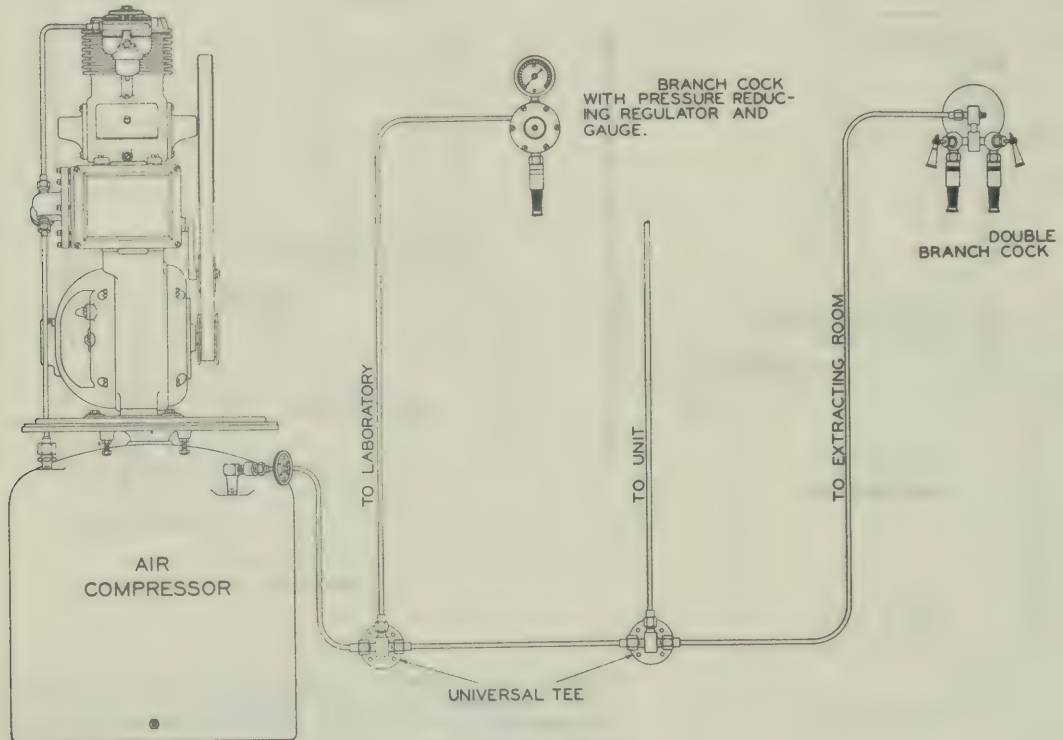


FIGURE No. 3

Showing three air outlets with the compressor unit in the laboratory connected to end of air line. The outlets can be arranged in different rooms, one near the bench in the laboratory with a pressure regulating valve, one to the Unit in the operating room, and one for the extracting room with pressure regulating valve or branch cock, single or double.

BELT - Place belt on pulleys "right way" as shown in Figure No. 4 making sure that smooth side of belt is in contact with surface of pulleys. If belt does not run in center of pulleys, turn it around but do not turn it over, for smooth side must be in contact with surface of pulleys to give best results.

METAL COVER - The enameled sheet metal cover for enclosing the entire compressor unit should rest on the felt cushion on the supporting plate. It is held in place by means of a thumb-screw, which passes through the cover into a hole in the cylinder head.

AUTOMATIC SWITCH - The automatic switch is usually set to stop motor when

RITTER AIR COMPRESSOR

pressure in tank has reached 42 pounds, and to start it again when pressure has fallen to about 30 pounds. If higher or lower pressures are desired, turn the adjustment nut (which regulates the tension of the large central main spring) to the right or in a clockwise direction, to increase the pressure; and to the left to decrease the pressure. The automatic switch will require no attention excepting examination of the contact fingers or brushes occasionally, as these may need cleaning once in a while, after which a very small amount of oil should be applied to inside faces, by means of a toothpick.

CAUTION - Do not use an oil can for this purpose as but very little oil is necessary.

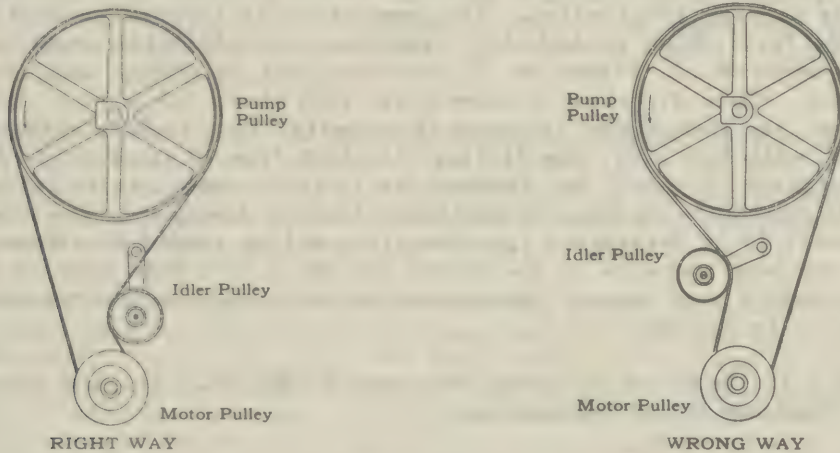


FIGURE NO. 4

LUBRICATION OF MOTORS - A can of oil, suitable for either motor or compressor, is supplied with every outfit. The frequency with which the motor should be oiled depends to a considerable extent, upon the amount of use given the compressor and can best be learned by experience.

The direct current motor is equipped, at both ends, with underfeed oil cups. These cups can be filled through the holes provided at the sides of the bearings. About ten or twelve drops of oil should be placed in each cup about every week.

The alternating current motor is equipped, at both ends, with oil receptacles packed with woolen yarn. Ten or twelve drops of oil should be placed in each receptacle every one or two weeks.

If after a time the amount of oil stated is found to be excessive, resulting in oil running over the lower part of the motor, reduce the amount.

REPLACING AND ADJUSTING COMMUTATOR BRUSHES - The brushes must slide easily in holders and press firmly on the commutator. Examine the brushes and clean brush holders regularly.

The proper adjustment for the brush holder tension springs is carefully set at the factory and should not be disturbed. However, in case of necessity, an adjustment is provided by means of which the pressure exerted on the brushes can be varied as required.

If commutator becomes dull black, clean with soft cloth. Should it become rough use fine sand paper while motor is running.

RITTER AIR COMPRESSOR

To renew brushes it is necessary to merely draw back the tension lever, remove old brush and insert new one. New brushes must be properly shaped to fit the commutator by the use of a strip of fine sand paper, inserted between them and the commutator while the armature is rotated back and forth.

Most troubles are due to lack of oil, loose connections, worn brushes, dirty commutator or brushes sticking in holders.

OILING AIR COMPRESSORS - All moving parts of the compressor pump are oiled by means of the splash system, viz., the bottom of the crank case is filled with oil and the ends of the connecting rods as they revolve dip into this oil, splashing it on all parts needing lubrication. The compressor is shipped without oil in it. Therefore the first thing to do before starting, is to fill the crank case with oil by removing screw No. 6, Figure No. 1; then pour oil in slowly until it overflows from the hole. (Note direction on name-plate just above oil hole.) After filling replace screw, see that washer is under it properly, then tighten with screwdriver; otherwise oil will leak out. One filling will last from 10 to 30 days, depending on how much compressor is used, but inasmuch as it is a simple matter to take out the screw, it is desirable to observe depth of oil more frequently for the first few months or until it is determined just how often oiling should be attended to. The bearing of the pump opposite to the pulley end has a celluloid disc in it, so that oil can be readily seen coming through bearing and returning to crank case, while compressor is in motion.

VALVES - If the motor and pump run properly but fail to give pressure, the valves and diaphragm should be examined.

If the diaphragm, located in case No. 7, Figure No. 1, is cracked, the motor and pump will run constantly but no pressure will develop. To view the diaphragm proceed as follows: Disconnect unions No. 3 and No. 10, Figure No. 1, then remove the eight screws which hold the diaphragm cover. The pipes and cover can now be lifted off without disturbing anything else. Care should be taken not to bend the pipes out of shape. If the diaphragm is found to be cracked, it is now a simple matter to replace it with a new one. When replacing the diaphragm cover, be sure that the packing washer is intact and in its proper place; then tighten the screws all uniformly, each one a little at a time. This draws the cover evenly and securely into place.

Leaky valves will be of very rare occurrence but should one develop a leak after long operation, it can be easily inspected by taking out screw No. 1, then the two caps No. 2 can be lifted up by placing a knife blade or similar instrument under the edge, being careful not to let them fly up as there is a spring under them. The two upper or exhaust valves are most likely to give trouble, therefore it may not be necessary to examine the lower intake valves. If care is taken when examining the upper valves, the exhaust valve cage No. 4, Figure No. 1, will remain in place even though the screw 1 has been removed. The valves are plain discs, if they fail to seat properly they leak air, in which case clean the face (*which has been down*) and examine the seats on which the valve discs rest, for undoubtedly some foreign matter has lodged on them and will not allow them to seat properly.

IMPORTANT - Do not scratch, mar or bend the valve seats or disc valves, otherwise it will be extremely difficult to get them tight again. Sometimes a valve will leak slightly when first put into operation, but after a few hours running will seat itself and be perfect thereafter.

FAILURE TO START - If the motor fails to start, make certain that the current

RITTER AIR COMPRESSOR

leading to the compressor is turned on and that all electrical connections are tight. If this does not prove to be the cause of the trouble, remove the automatic switch cover and examine the contact fingers. The contact on the end of the movable lever must necessarily touch both of the contact fingers, to close the circuit. A drop or two of oil, applied to inside faces of these fingers, facilitates the contact in moving in and out, but oil should be applied only in case they are entirely dry and then but a drop or two at the most.

To ascertain whether the failure to start is due to the motor or to some other part of the outfit, remove the belt and then connect the two supply wires directly onto the two terminal posts on the motor; if the latter starts and runs properly it indicates the trouble is in some other part of the outfit, probably in the two contact fingers mentioned above.

FAILURE TO STOP - If motor fails to stop when maximum pressure has been reached for which the automatic switch is set, the trouble is in the latter. Examine contact fingers as these may be stuck or possibly some of the pivots need a drop of thin oil. The trouble may also be due to leaks in valves or pipe connections or the diaphragm may be cracked. See headings, "Valves" and "Air Leaks".

TAKING UP WEAR - If connecting rod bearings become noisy they can be taken by means of adjustment screws, located on lower parts of the rods where they fasten to the crank shaft. To get at these, the hand hole cover must be removed by removing screw No. 5. When replacing this cover be sure the paper washer or gasket is intact, otherwise oil will leak out and run down the Automatic Switch. It is advocated that the surface of metal be carefully cleaned and that a coat of thin shellac be applied thereto before attaching the cover.

COTTON CHAMBER - The pump is provided with a cotton receptacle, through which all air is drawn, thus preventing dirt from getting into the valves. The cotton should be removed occasionally by turning the receptacle to the left slightly and then pulling it down. It is held only by means of an ordinary bayonet lock.

An additional cotton receptacle is provided in the diaphragm cover. The cotton should be renewed occasionally by removing the cap from the end of the receptacle.

WATER IN TANK - Every week it is essential, to draw off the water (due to condensation) that accumulates in the air tank. The small drain cock near bottom of tank is for this purpose and can be opened with a screw driver, it not being necessary to turn it more than two or three turns. After water has drained off, be sure to tighten it again.

AIR LEAKS - If pump starts at more frequent intervals than it should, it indicates that there is an escape of air and the leaks should be located at once. The pipe leading from pump to tank may not be tight at the couplings, or a soldered joint may have opened up. Test same by applying oil as previously described. A leak may occur around the diaphragm, No. 8. If so, tighten the screws that hold the diaphragm cap in place. If all connections and parts are found tight about the compressor and air tank, then look for leaks in the pipe line or other air operated appliances. Closing the main valve No. 12 disconnects all appliances and if under these conditions the compressor seems to hold the pressure properly, it indicates conclusively that the leak must be in the pipe line or appliances. If the compressor valves are not tight, leakage will take place past the pistons and into crank case. In this event examine the valves as explained under the heading, "Valves".

SECTION LXIX

PELTON AIR COMPRESSOR

PELTON AIR COMPRESSOR OPERATION AND UPKEEP

ASSEMBLY - The Compressor is shipped completely assembled with the exception of the cover, which is packed separately in shipping.

Check four rubber mountings under pump supports, and four motor base bolts, making sure that all are screwed down as tightly as possible.

Check all air connection couplings, making sure each is tight, and be sure intake filter is loosely packed with clean absorbent cotton. Tighten filter and conditioner caps tightly, using a wrench on the latter to insure its being air tight. Cotton in filter should be replaced at regular intervals to maintain proper filtration. Felt packing in conditioner will occasionally require replacement.

If permanent air lines are to be soldered to the tank outlet valve, before attaching be sure the location selected for the Compressor provides a perfectly level base and will be accessible for regular lubrication and replacement of cotton in filter.

CHECK VOLTAGE BEFORE CONNECTING - Be sure current supply on which Compressor is to be used is not more than 10% above or below voltage stamped on Compressor nameplate (if for alternating current, also be sure frequency in cycles corresponds with frequency on nameplate).

LUBRICATE REGULARLY - The importance of regular oiling cannot be over-emphasized. Oil the Compressor properly at least once a week at regular intervals.

Use good grade of S. A. E. 30 motor oil, and lubricate regularly the following parts:

1. 2 Oil Cups on main shaft bearings.
2. 1 Oil Cup on wrist bearing.
3. 2 Oil Wells on motor bearings.
4. Cylinder Wall.

In lubricating the cylinder wall, turn main pulley until piston is at top of stroke, at which point it will project slightly above top of cylinder. Fill space thus formed between piston and cylinder with a few drops of oil, but do not lubricate to excess.

DRAIN TANK REGULARLY - Moisture formed by condensation in outside air lines will accumulate in Compressor Tank, particularly when Compressor is located below air outlets. When air from tank begins to indicate presence of moisture, drain tank by removing drain plug cap at bottom and tipping tank slightly on edge. When replacing drain plug cap, be sure rubber gasket is in place inside cap.



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PRESSURE CONTROL SWITCH - The Compressor is equipped with an improved type pressure switch, which automatically turns off current to the motor when tank pressure reaches 40 lbs., and automatically starts again when tank pressure drops to 25 lbs. This standard setting is satisfactory in most cases, but can be changed, if desired, to meet individual requirements. Remove round retaining nut on top of cover, and remove cover. Pressure adjusting nut on center post should be tightened downward to increase stopping and starting pressures, and vice versa. One full turn of nut changes *both* stopping and starting pressures approximately 8 lbs. To change *differential* between stopping and starting pressures, turn screw accessible through side of housing. Turning screw in or clockwise widens differential (approximately 4 lbs. per quarter turn), and vice versa.



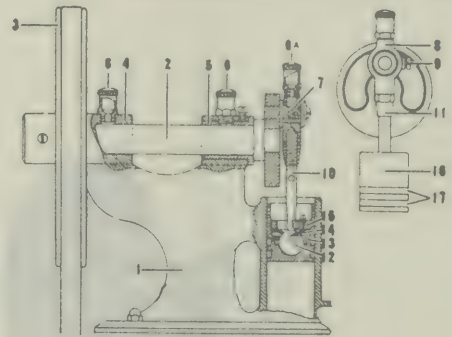
OVERLOAD RELAY - In the event of sudden fluctuations in line voltage, or should the Compressor be stalled for any reason, current to the motor will be automatically disconnected by an overload relay incorporated in the pressure control switch. When the circuit has thus been opened, the white line on the cutoff switch button acts as a visible indication that the motor has been turned off. Pressing the switch button back into position resets the overload relay and again starts the motor. The switch button can be reset in approximately one minute after automatically operating.

The cutoff switch button can also be used manually for turning the motor on and off. *It is recommended that current be turned off every night, or when the Compressor is to remain idle for any length of time.*

ADJUSTMENTS

CONNECTING ROD BALL - Adjustment at this point will not ordinarily be required until the Compressor has been in service several years. When wear has become sufficient to cause play on the connecting rod ball, it can be compensated for as follows:

Turn the piston in the cylinder so that the set screw in the slotted adjusting nut is directly below the set screw in the wrist-bearing above. Loosen the set screw in the adjusting nut, and holding the piston so that it cannot revolve, turn the adjusting nut downward or clockwise 1/2 turn, using a screw driver in the slot in the nut. Check the fit of



Pump Detail

1. Cylinder and drive support casting.
2. Pump drive shaft with crank plate.
3. Drive shaft pulley.
4. Drive shaft bearing, rear.
5. Drive shaft bearing, front, with set screw.
6. Drive shaft bearing oil cup.
- 6a. Wrist bearing oil cup.
7. Wrist bearing pin.
8. Wrist bearing.
9. Wrist bearing adjusting screw.
10. Connecting rod.
11. Connecting rod adjustment lock nut.
12. Connecting rod ball.
13. Connecting rod ball seat.
14. Connecting rod ball seat washer.
15. Connecting rod ball adjustment nut.
16. Piston.
17. Piston ring.

PELTON AIR COMPRESSOR

the ball joint by turning the pump pulley by hand. If 1/2 turn of the nut is not sufficient, turn the nut back to its original position, and give it 3/4 turn downward. When play in connecting rod ball has been eliminated, tighten set screw in adjusting nut.

CAUTION: Do not tighten adjusting nut to point where binding occurs.

MAIN BEARING - Looseness in the main bearing is indicated by a heavy knock when the Compressor is in operation, or it can be detected by grasping the pump pulley and endeavoring to shake the main shaft. To tighten, remove driving belt, and turn main bearing set screw down or clockwise until a snug fit without looseness is provided, as shown by revolving pump pulley by hand.

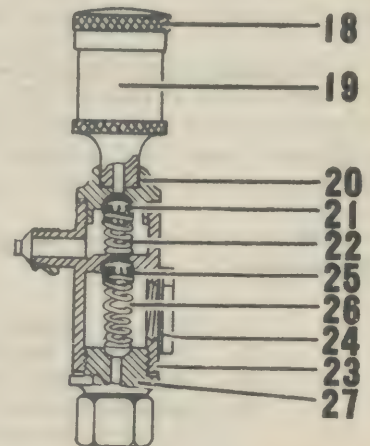
WRIST BEARING - Wear in the wrist bearing can be compensated for as follows: Remove driving belt, and loosen lock nut on wrist bearing set screw. Turn set screw in or clockwise until a snug fit without looseness is attained. (Check by revolving pump pulley by hand.) Looseness in the wrist bearing is indicated by a light knock when the Compressor is in operation.

CONNECTING ROD - Adjustment of this part will be necessary only when a new piston is installed. The rod then should be adjusted so the piston has a clearance of 3/64" at the bottom of its stroke. To check, turn crank until piston is at bottom of stroke, then loosen lock nut on upper end of connecting rod and turn rod clockwise until piston bottoms in cylinder. Then turn rod upward or counter-clockwise exactly three one-half turns (1 1/2 full turn), and tighten lock nut.

DRIVING BELT - Adjustment of the driving belt will seldom be required, as this belt is properly pre-stretched when manufactured. Should the free movement or slack in the belt ever exceed one inch off a straight line between pulley rims, remove motor base nuts, lift motor up and remove spacers beneath motor base, replacing motor as before. In checking belt slack, do not mistake inherent elasticity of the belt for free movement.

VALVE SYSTEM - The check and intake valves in the Compressor require no attention. When replacements are necessary, it is advisable to replace both check and intake valves, and to use new springs with each.

The check valve has the longer spring of the two, and is accessible by removing the closing nut on the side of the valve body. Install the new valve and spring by inserting the plain end of the spring first and compressing the spring so the valve ball can be snapped into place. Replace the body closing nut and tighten with a wrench.



Valve System Detail

- 18. Intake valve filter cap.
- 19. Intake valve filter body.
- 20. Intake valve seat.
- 21. Intake valve ball.
- 22. Intake valve spring.
- 23. Valve system body.
- 24. Valve body closing nut.
- 25. Check valve ball.
- 26. Check valve spring.
- 27. Valve body outlet with nipple and nut.

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The intake valve is accessible by removing the intake filter and the bushing into which it fits. This bushing also contains the intake valve seat. Insert the new valve with the plain end of the spring down, and replace bushing and intake filter.

All air line connections on the Compressor and also at other points in the system should always be kept air-tight. Leakage at any point will cause unnecessary operation of the Compressor. When such operation indicates the presence of a leak, determine first if it is somewhere outside the Compressor by closing the tank outlet valve. If the Compressor continues to operate with tank outlet valve closed, leakage may be at one of the connections between pressure control switch and conditioner; between conditioner and tank, or tank drain plug may not be tight. If at none of these, leakage will probably be in valve system, in which case replace check and intake valves, as above.

To locate leaks, apply soapy water to each connection in turn; watch closely for bubbles. Leaks should be located and eliminated immediately to prevent unnecessary Compressor operation.

GENERAL INFORMATION - The Standard Type, including Models A-61, A-62, D-11 and D-22, has a bore of 1.25" and a stroke of 1.50", producing 985 cu. in. free air per minute, at a driven pulley speed of 542 r.p.m. (motor speed 1750 r.p.m.). This is sufficient to produce 40 lb. pressure in 8-gal. tank in 5 minutes, 55 seconds, and to pump from 25 lb. pressure (automatic starting point) to 40 lb. pressure (automatic cutoff point) in 2 minutes, 55 seconds.

The Heavy Duty Type including Models A-610, A-620, D-110 and D-220, has a bore of 1.56" and a stroke of 2", producing 2100 cu. in. free air per minute at a driven pulley speed of 542 r.p.m. (motor speed 1750 r.p.m.). This produces 40 lb. pressure in 12-gal. tank in 5 minutes, 45 seconds, and pumps from 25 lb. pressure (automatic starting point) to 40 lb. pressure (automatic cutoff point) in 1 minute 45 seconds.

When a pump does not produce these results, any of the following may be responsible:

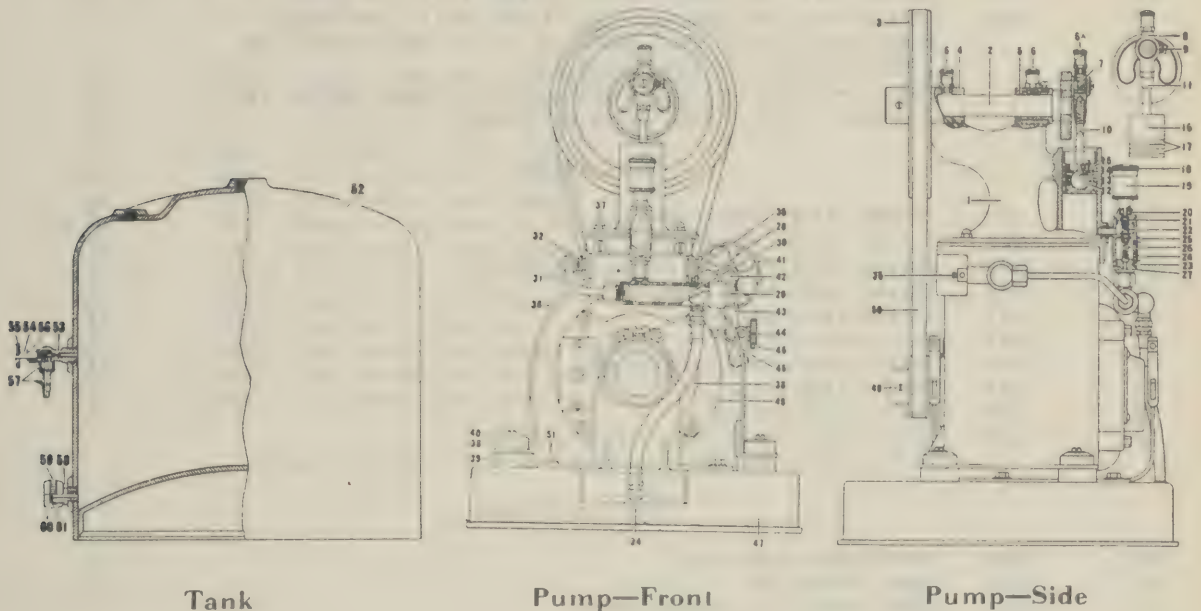
1. Lack of proper lubrication, causing binding.
2. Imperfect seating of check or intake valves.
3. Low voltage - motor running at reduced speed.
4. Leakage in air line or at outlets.

The Pelton Compressor Motor is of 1/4 h.p., with a speed of 1750 r.p.m. Its bearings are rubber-mounted to minimize vibration, and the motor requires no attention other than regular lubrication. Be sure the motor is never operated on current more than 10% above or below voltage stamped on Compressor nameplate (if alternating current be sure frequency in cycles corresponds with frequency on nameplate).

When corresponding regarding your Compressor, always mention Model Number, serial number and voltage (also frequency if for A.C.).

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REPLACEMENT PARTS - Parts are numbered on the diagram below for convenience in determining parts required. When ordering parts, however, give factory part numbers as shown in the parts list on the following pages. Also, be sure to state model number, and serial number of compressor for which parts are ordered, together with current voltage (and frequently if for alternating).



Tank

Pump—Front

Pump—Side

PARTS LIST

Diagram No.	Factory Part No.	Description	Number Required
PUMP HEAD			
I	2176	Cylinder and drive support casting for Models A-61, A-62, D-11 and D-22	I
1	2232	Cylinder and drive support casting for Models A-610, A-620, D-110 and D-220	1
2	2214	Pump drive shaft with crank plate for Models A-61, A-62, D-11 and D-22	I
2	2231	Pump drive shaft with crank plate for Models A-610, A-620, D-110 and D-220	1
3	2175	Drive shaft pulley with set screw	I
4	218	Drive shaft bearing, rear or pulley end	I
5	219	Drive shaft bearing, front or crank end	I
6	242	Drive shaft bearing oil cup, each	2
6-A	242	Wrist bearing oil cup	I
7	248	Wrist bearing pin with washer	I
8	250	Wrist bearing with housing	1
9	2186	Wrist bearing adjusting screw with lock nut	I
10	222	Connecting rod only	I
11	236	Connecting rod adjustment lock nut	1
12	240	Connecting rod ball	I
13	237	Connecting rod ball seat	1
14	278	Connecting rod ball spring washer, each	2
15	234	Connecting rod ball adjusting nut and set screw	I

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Diagram No.	Factory Part No.	Description	Number Required
16	221	Piston only, for Models A-61, A-62, D-11 and D-22	1
17	207	Piston ring, for Models A-61, A-62, D-11 and D-22	2
16	285	Piston only, for Models A-610, A-620, D-110 and D-220	1
17	286	Piston ring, for Models A-610, A-620, D-110, and D-220	2
		Pump Assembly complete, including all of above parts, for Models A-61, A-62, D-11 and D-22	
		Pump Assembly complete, including all of above parts, for Models A-610, A-620, D-110 and D-220	
VALVE SYSTEM			
18	230	Intake valve filter cap	1
19	217	Intake valve filter body	1
20	2198	Intake valve seat or filter receptacle	1
21	258	Intake valve ball	1
22	257	Intake valve spring	1
23	2197	Valve system body	1
24	224	Valve system body closing nut	1
25	258	Check valve ball	1
26	256	Check valve spring	1
27	2199	Valve body outlet with nipple and nut	1
		Valve System Assembly, complete with all of above parts	
AIR CONDITIONER			
28	2201	Conditioner body only	1
29	2202	Conditioner cap	1
--	2203	Conditioner cap packing washer	1
30		Conditioner felt filter	
		Air Conditioner Assembly, complete	
CONNECTIONS			
31	2212	Connecting pipe, pressure switch to conditioner, with connections	1
32	2218	Connecting tube elbow	1
33	2213	Connecting tube, conditioner to tank, with connections	1
34	223	Connecting tube tank nipple	1
PRESSURE SWITCH			
35	2179	Automatic pressure switch complete	1
		Automatic pressure switch, exchanged	
PUMP SUPPORT			
36	2177	Pump supporting arch, complete	1
37	2223	Pump casting attaching screw cap nut, each	2
38	2180	Pump support rubber mounting (top), each	4
39	2181	Pump support rubber mounting (bottom), each	4
--	2182	Pump support rubber mounting core, each	4
40	2211	Rubber mounting screw with spacer, each	4
MOTOR			
48	2172	Motor only for 110-volt direct current, or 110-volt, 60-cycle, alternating current	
		Motor only for direct current other than 110-volts	
		Motor only for alternating current other than 110-volts, 60 cycle	
49	2173	Motor pulley	1

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Diagram No.	Factory Part No.	Description	Number Required
50	2174	Motor driving belt	1
51	2169	Motor base bolt with washer, each	4
--	2234	Motor connecting cord with plug	1
TANK AND COVER			
52	2170	8-gal. tank only (specify finish)	1
52	2233	12-gal. tank only (specify finish)	1
47	2171	Tank top or mounting platform	1
53	264	Tank outlet valve body	1
54	261	Tank outlet valve stem	1
55	262	Tank outlet valve handle	1
56	263	Tank outlet valve packing nut	1
57	284	Tank outlet valve nipple with nut	1
53-57	261-4	Tank outlet valve, complete	1
58	966	Tank drain plug nipple	1
59	967	Tank drain plug cap	1
60	968	Tank drain plug rubber disc	1
61	969	Tank drain plug metal disc	1
--	2221	Tank cover with swinging door (specify finish)	1

SECTION LXX

PORTABLE ELECTRIC ASPIRATING UNIT ON STAND

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PORTABLE ELECTRIC ASPIRATING UNIT ON STAND

GOMCO NO. 790 -W

UNPACKING AND ASSEMBLY - Remove corrugated carton from outer wooden case and open. Remove corrugated inserts and supports.

Remove parts from box packed between the legs of the unit and assemble as shown in Figure 1. Place Vacuum Bottle 243 between brackets on top of stand. The Bottle Cap 252 Combination is already assembled to the Bottle Cap 242 so slip the latter over the Vacuum Bottle. Attach the One Foot Rubber tube 247 between the Safety Overflow Valve above pump and the plain connection of bottle top. Attach the Five Foot Rubber Tube 246 to other side of stand as illustrated in Figure 1.



Fig. 1 Front View
of Complete Unit

Only in exceptional cases will it be necessary to change the position of the adjusting valve. Screwing the adjustment nut down will increase the degree of suction. Check to make certain bottle cork and tubing connections are air tight.

Slip the four Casters 267 into the bottom of the stand legs. The Coupland Type Suction Handle 255 with No. 2 and No. 4 tips can be laid in the stand drawer until required for use. This handle is slipped into the end of Rubber Tube 246 and whichever tip is desired is slipped into the end of the handle.

The can of Electric Motor Oil 235 and the Chamois Discs 238 should be kept in the drawer or other convenient place for service use. It is suggested the manual too be kept in the stand drawer for reference.

Plug line cord into electric outlet of current indicated on nameplate of unit.

OPERATION - Turn Adjusting Valve Control Knob 201 on top of bottle in to full extent. Remove oil well Screw 229 (Figure 2) and see that reservoir is filled with oil from can supplied. Replace screw and washer and start pump running by turning on line cord switch 245.

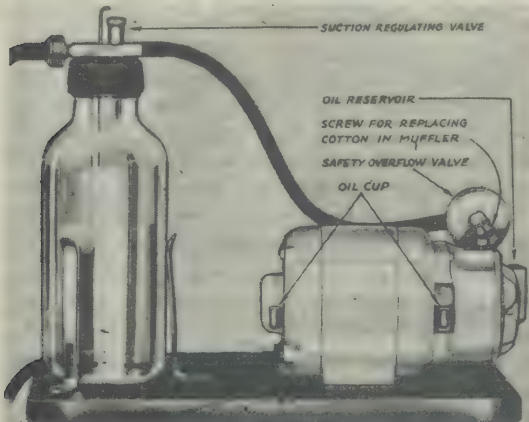


Fig. 2 Side View of Unit

This unit is used to aspirate blood and mucous from the field of operation during surgery. This can be done by slipping the Coupland Type Handle with either size tip as supplied with the unit into the end of the rubber tube leading from the vacuum bottle or by using any other desired suction tube or handle.

CARE AND MAINTENANCE OF BOTTLE ASSEMBLY

The Vacuum Bottle 243 should be emptied frequently and should never be allowed to fill above the line indicated on the label.

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The Five Foot Rubber Tube 246 leading from bottle to suction handle should be removed from the connections after use and cleaned in water.

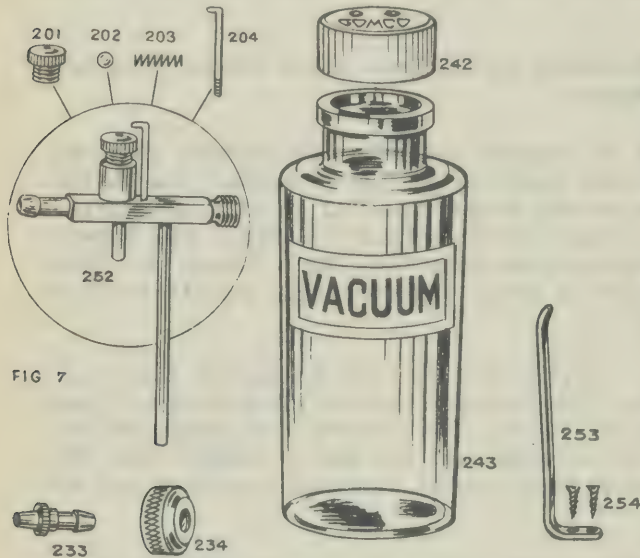


Fig. 3 Detail of Bottle Assembly

Should any fluid enter the one Foot Rubber Tube 247 leading from bottle to overflow valve, this tube should be removed and cleaned in water and *thoroughly* dried to prevent fluid entering the safety overflow valve.

The Rubber Cap 242 should always seat so as to cause a perfect seal. It should also be cleaned in water after use.

SPARE PARTS - The 32 ounce Glass Vacuum Bottle 243 may require replacement from time to time as result of breakage.

The Rubber Cap 242 and Rubber Tubes 246-247 may deteriorate in time and require replacement.

NOMENCLATURE LIST

No. 201 Adjusting Valve Control Knob
No. 202 Adjusting Valve Ball Check
No. 203 Adjusting Valve Spring
No. 204 Adjusting Valve Check Arm
No. 233 Tapered Tube Fitting
No. 234 Tube Connection Nut

No. 242 Vacuum Bottle Cap
No. 243 32 ounce Vacuum Bottle
No. 246 Five Foot Rubber Tube
No. 247 One Foot Rubber Tube
No. 252 Bottle Cap Combination
No. 253 Bottle Bracket
No. 254 Steel Wood Screw, F.H.No. 6¾"

CARE AND MAINTENANCE OF PUMP ASSEMBLY

OILING - Oil to the pump is supplied from the large oil reservoir built into the Pump Cover 231 (Figure 2, 4, 5, 6). This reservoir should be filled every 24 hours of use with electric motor oil supplied with the apparatus. The reservoir must be kept closed tightly by means of the Screw 229 and Washer 230.



Fig. 4 Pump End View of Unit

MUFFLER - All air passes out of the pump thru the air muffler. The cotton in this muffler should be replaced at least every six months by removing the Screw 249 (Figure 5, 6), taking out the old cotton and inserting new cotton by packing it very loosely. Caution should be used to pack the cotton loosely as the suction power of the pump will be greatly reduced if the muffler is too tightly packed. Likewise, if the suction power of the pump does not appear satisfactory, it is suggested the muffler cotton be replaced as it may be oil soaked. It should be

PORTABLE ELECTRIC ASPIRATING UNIT ON STAND

replaced whenever it is found to be contaminated with foreign matter.

SAFETY OVERFLOW VALVE - The Safety Overflow Valve protects the pump unit against flooding. The operating principle of this valve is based on the fact that chamois will allow free passage of air but not liquids. When fluid strikes the chamois, the impedance created causes the valve to close. The pump will continue to operate but no fluid can pass thru the valve.

If it is noted there is no suction at the suction handle and the bottle has been allowed to overfill, it becomes necessary to replace the chamois disc in the Safety Overflow Valve. This should be done immediately when this condition is noticed.

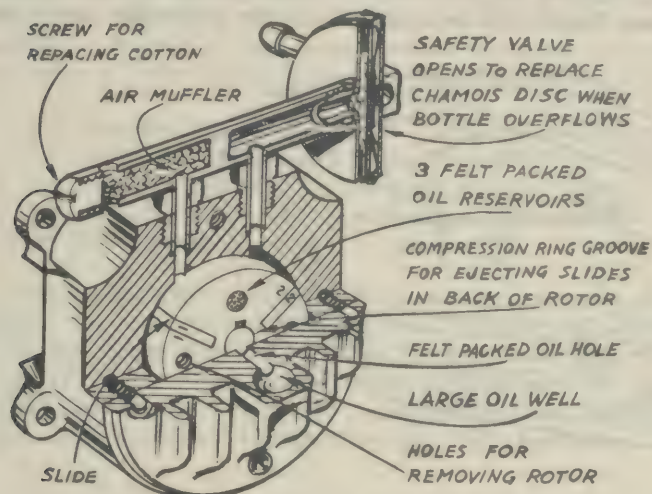


Fig. 5 Cross Section of Pump Assembly

Allow the pump to continue running and remove the Valve Cover 236 (Figure 4, 6) by twisting it off. Then shut off pump and remove the saturated chamois Disc 238 and Slotted Spring 239. Thoroughly clean and dry all the valve parts. Remove the rubber tube leading from valve to bottle, wash in water, and dry thoroughly before putting it back on.

To reassemble valve, put Slotted Spring 239 back in place with the washer part toward the

back of the valve. Do not exert undue pressure on it. The pump may then again be started to insure seating of a new Chamois Disc 238 so its entire metal edge is confined within the valve recess. Lock the Cover 236 back on the valve with a light turn.

Should the valve close after replacing the cover, there must be moisture reaching the chamois disc. The valve should be disassembled and dried more thoroughly and the tubing should also be dried more thoroughly. The valve may close by itself if the rubber tube leading to it is compressed suddenly--stop the pump for seconds and it will reopen.

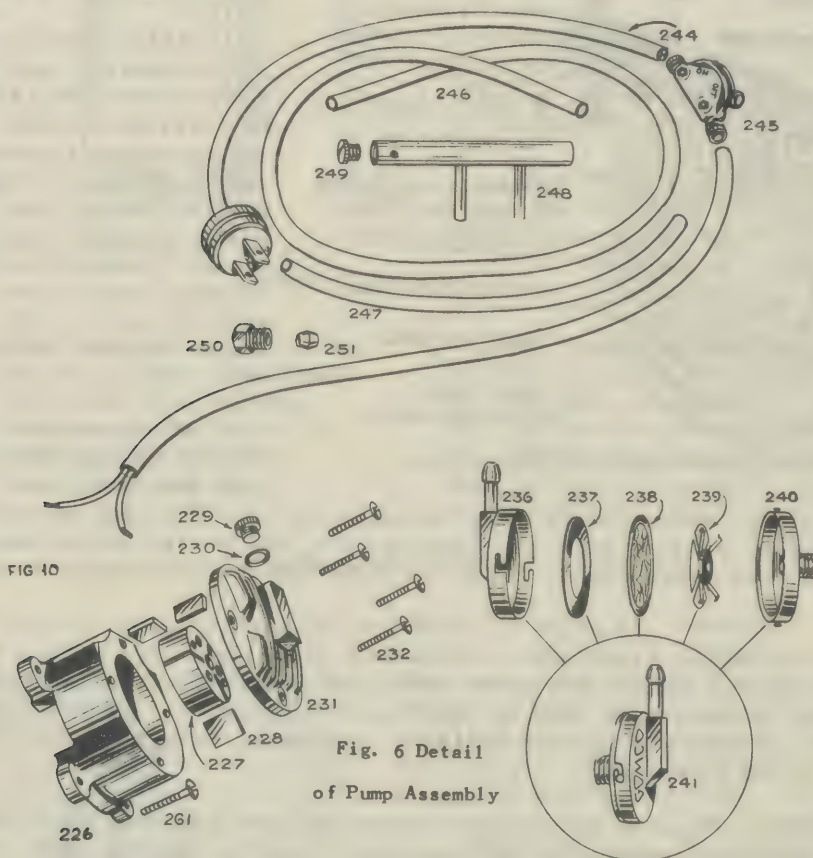
SPARE PARTS - Three extra Chamois Discs 238 are supplied with the unit when shipped and additional quantities are available from the manufacturer. A two ounce can of Electric Motor Oil 235 is also supplied with the apparatus and additional quantities can be received from the manufacturer.

REPAIRS - A slightly flooded pump or old gummy oil may make the pump unduly noisy and the motor unusually warm. It may be possible to correct this without cleaning the entire pump by simply flushing the pump with kerosene. Open the Safety Overflow valve and remove the chamois disc and slotted spring as instructed above under "Safety Overflow Valve". Remove cotton from muffler by removing Screw 249 (Figure 5, 6). Hold a rag over muffler opening and with the pump running, drop enough kerosene into the opening in the center of the Safety Overflow Valve back until it has been sucked thru the pump and is being expelled from the muffler side against the rag. Keep the pump running until no more kerosene is being expelled and then with the pump still running, place a few drops of Electric Motor Oil into the same places where the kerosene was placed. Allow the pump to run for about fifteen minutes. The

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rag need be held against the muffler only as long as oil is being expelled. After stopping the pump wipe out the air muffler, replace cotton in muffler as instructed under "Muffler" above and reassemble Safety Overflow Valve as previously instructed. Fill the oil reservoir in the pump cover and then if the pump runs more freely, if it is no longer noisy, and the motor does not overheat, the difficulty has been overcome.

If flushing does not correct the difficulty, it will be necessary to clean the pump. This is done by withdrawing the four Screws 232 holding the Cover 231 (Figure 4, 6). Take the cover away and inside the pump will be found the Rotor 227 with three slots and three slides 228 (Figure 4, 6) lying in the slots. Two threaded screw holes will be seen facing the outside in the rotor. Insert two of the screws which held the pump cover into these holes and remove the rotor from the shaft by



NOMENCLATURE LIST

No. 226 Pump Body	No. 237 Overflow Valve Cover Gasket
No. 227 Rotor	No. 238 Chamois Disc
No. 228 Rotor Slides	No. 239 Slotted Spring
No. 229 Screw for Oil Reservoir	No. 240 Overflow Valve Back
No. 230 Washer for Oil Reservoir	No. 241 Complete Overflow Valve
No. 231 Pump Cover	No. 248 Valve and Muffler Bar
No. 232 Screws, R. H. Steel 3-32 x 7/16	No. 249 Screw and Muffler Bar
No. 236 Overflow Valve Cover	No. 250 Compression Nut
	No. 251 Compression Sleeve

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placing a screw driver under the head of each screw and by lever action against the sides of the pump, evenly withdraw the rotor. Remove the sides from the rotor and thoroughly clean the pump inside, the rotor and slides, with kerosene. Wipe dry and then wipe the surfaces with a small amount of oil and place the slides back into the rotor. Be certain the slides are placed in the same numbered slot, Figure 5, as stamped. Place the rotor back on the shaft after making certain the woodruff key is properly seated in the shaft. The side of the rotor with the two screw holes must face out.

In replacing the rotor, tap it with a wood mallet, not steel. Undue force must not be used nor a hammer be used on the rotor or the pump parts--the slightest burr or mark on any of the surfaces will cause a poor operating pump. When replacing the cover, see that all dirt is wiped off from the cover and the surface to which it is applied. Tighten the four screws holding the cover, evenly, and fill the oil reservoir in the cover. Replace muffler cotton by method outlined under "Muffler".

MOTOR CARE AND MAINTENANCE - The motor is of the sleeve bearing type. It has two oil cups 215 one on each end (Figure 2, 7). Some motors have two oil holes in the top of the end bells instead of the cups on the side. About six drops of Electric Motor Oil as supplied with the apparatus should be placed in each oil cup or hole twice yearly.

MOTOR REPAIR - It may be found necessary to replace the cut-out mechanism 219 (Figure 7), mounted in the end bell facing the bottle of the motor develops a growl and smokes when running. There is no assurance, however, that this is the cause of the difficulty and because the replacement of such a mechanism is difficult to accomplish in the field, it is suggested the motor be returned to the manufacturer repair and thorough reconditioning and check-up.

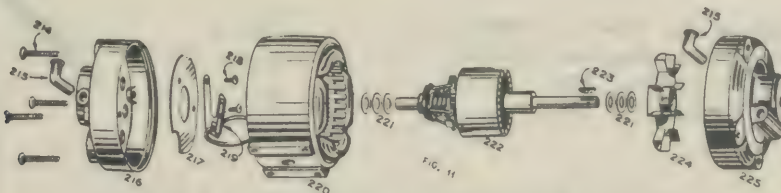


Fig. 7 Detail of Electric Motor

NOMENCLATURE LIST

No. 214 End Bell Screws R. H. Steel 8/32 x 1 1/4"	No. 221 Thrust Washers
No. 215 Oil Cup	No. 222 Armature
No. 216 Front End Bell	No. 223 Woodruff Key
No. 217 End Bell Fibre Disc	No. 224 Ventilating Fan
No. 218 Cut-Out Mechanism Mounting Screws R. H. Steel 6/32 x 1/4"	No. 225 Rear End Bell
No. 219 Cut-Out Mechanism	No. 226 Pump to Motor Mounting Screws R. H. Steel 7/32 x 1 1/4"
No. 220 Motor Field Assembly	No. 244 Electric Cord with Plug
	No. 245 Electric Cord Switch

STAND CARE AND MAINTENANCE - The stand should be cleaned occasionally with soap and water. Casters may be oiled as required.

PORTABLE ELECTRIC ASPIRATING UNIT ON STAND

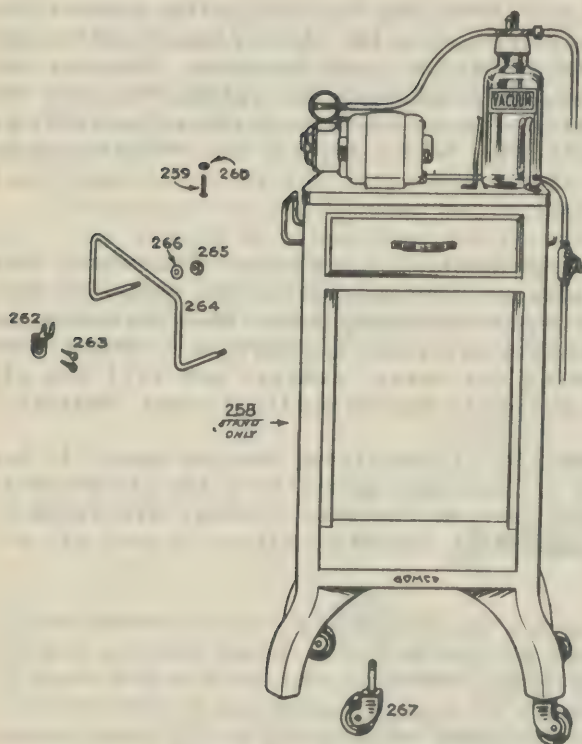


Fig. 8 Detail of Stand

NOMENCLATURE LIST

- No. 258 Stand only
- No. 259 Screw to hold motor on stand R. H. Steel 10/32 x 1 1/4"
- No. 260 Washer for No. 259
- No. 262 Tubing Hook
- No. 263 Screws for No. 262 Steel No. 4-3/8" Wood Screws
- No. 264 Towel Bar
- No. 265 Nut for No. 264
- No. 266 Washer for No. 264
- No. 267 Caster

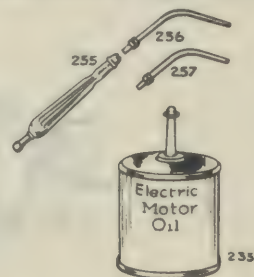
CARE AND MAINTENANCE OF ACCESSORIES - The Coupland Type Suction Handle and Tips should be cleaned after use.

SPARE PARTS - It is recommended that only Electric Motor Oil 235 of the type supplied with the unit be used to oil the motor and pump. A two ounce can is supplied with the unit and additional quantities can be secured by using item No. Dental Engine Oil.

NOMENCLATURE LIST

- No. 235 Two ounce can Electric Motor Oil
- No. 255 Coupland Type Suction Handle
- No. 256 No. 2 Tip for No. 255
- No. 257 No. 4 Tip for No. 255

Fig. 9
Detail of
Accessories



COMPLETE STANDARD NOMENCLATURE LIST

- | | |
|---|--|
| No. 201 Adjusting Valve Control Knob | No. 240 Overflow Valve Back |
| No. 202 Adjusting Valve Ball Check | No. 241 Complete Overflow Valve |
| No. 203 Adjusting Valve Spring | No. 242 Vacuum Bottle Cap |
| No. 204 Adjusting Valve Check Arm | No. 243 32 Ounce Vacuum Bottle |
| No. 214 End Bell Screws R. H. Steel 8/32 x 1 1/4" | No. 244 Electric Cord with Plug |
| No. 215 Oil Cup | No. 245 Electric Cord Switch |
| No. 216 Front End Bell | No. 246 Five Foot Rubber Tube |
| No. 217 End Bell Fibre Disc | No. 247 One Foot Rubber Tube |
| No. 218 Cut-Out Mechanism Mounting | No. 248 Valve and Muffler Bar |
| Screws R. H. Steel 6/32 x 1/4" | No. 249 Screw for Muffler Bar |
| No. 219 Cut-Out Mechanism | No. 250 Compression Nut |
| No. 220 Motor Field Assembly | No. 251 Compression Sleeve |
| No. 221 Thrust Washers | No. 252 Bottle Cap Combination |
| No. 222 Armature | No. 253 Bottle Bracket |
| No. 223 Woodruff Key | No. 254 Steel Wood Screw, F. H. No. 6 3/4" |
| No. 224 Ventilating Fan | No. 255 Coupland Type Suction Handle |
| | No. 256 No. 2 Tip for No. 255 |

PORTABLE ELECTRIC ASPIRATING UNIT
ON STAND

COMPLETE STAND NOMENCLATURE LIST (CONT'D).

No. 225 Rear End Bell	No. 257 No. 4 Tip for No. 255
No. 226 Pump Body	No. 258 Stand Only
No. 227 Rotor	No. 259 Screw to hold motor on stand
No. 228 Rotor Slides	R. H. Steel 10/32 x 1¼"
No. 229 Screw for Oil Reservoir	No. 260 Washer for No. 259
No. 230 Washer for Oil Reservoir	No. 261 Pump to Motor Mounting Screws
No. 231 Pump Cover	R. H. Steel 8/32 x 1¼"
No. 232 Screws R. H. Steel 8/32 x 7/16"	No. 262 Tubing Hook
No. 233 Tapered Tube Fitting	No. 263 Screw for No. 262
No. 234 Tube Connection Nut	Steel No. 4-3/8" Wood Screw
No. 235 Two Ounce Can Electric Motor Oil	No. 264 Towel Bar
No. 236 Overflow Valve Cover	No. 265 Nut for No. 264
No. 237 Overflow Valve Cover Gasket	No. 266 Washer for No. 264
No. 238 Chamois Disc	No. 267 Caster
No. 239 Slotted Spring	

MOUNTING ON UNIT DENTAL OPERATING

The Aspirator is also supplied to the Ritter, and Weber Dental Manufacturing Companies to be mounted on their dental operating units. There are only two variations to this foregoing in these applications.

The first is that the pump unit on the Dental Operating installations is inverted in that the suction outlet is on the bottom of the pump unit instead of the top. The second is that the Aspirators supplied with the operating units are mounted on shelves, covered with hoods, which are attached to the pedestal of the unit.

PORTABLE ELECTRIC ASPIRATING UNIT
ON STAND

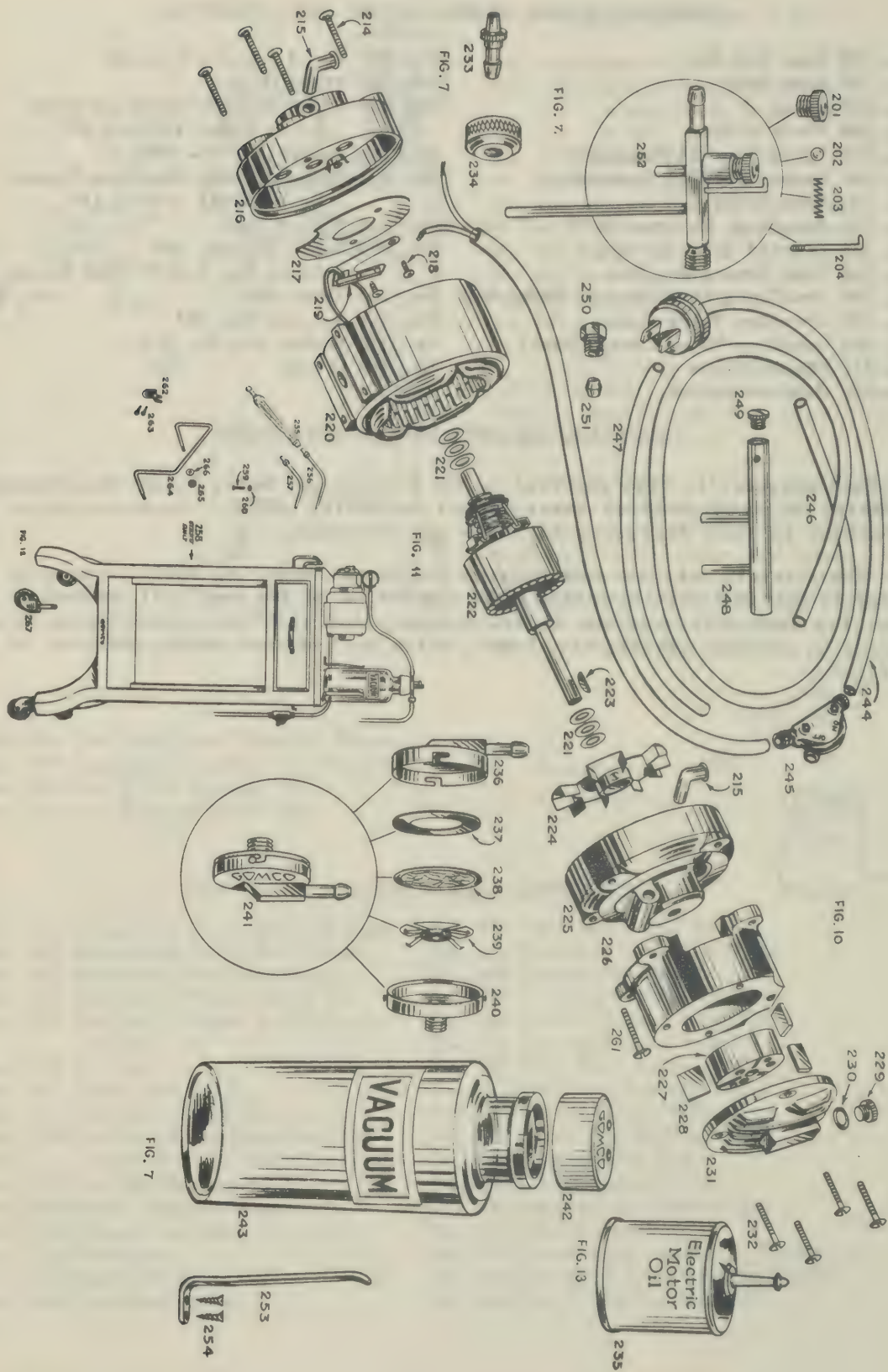


Figure 10 Detail of Parts for Portable Electric Aspirating Unit on Stand

SECTION LXXI

RITTER MODEL A DENTAL LATHE

RITTER DENTAL LATHE
MODEL "A" - ALTERNATING CURRENT

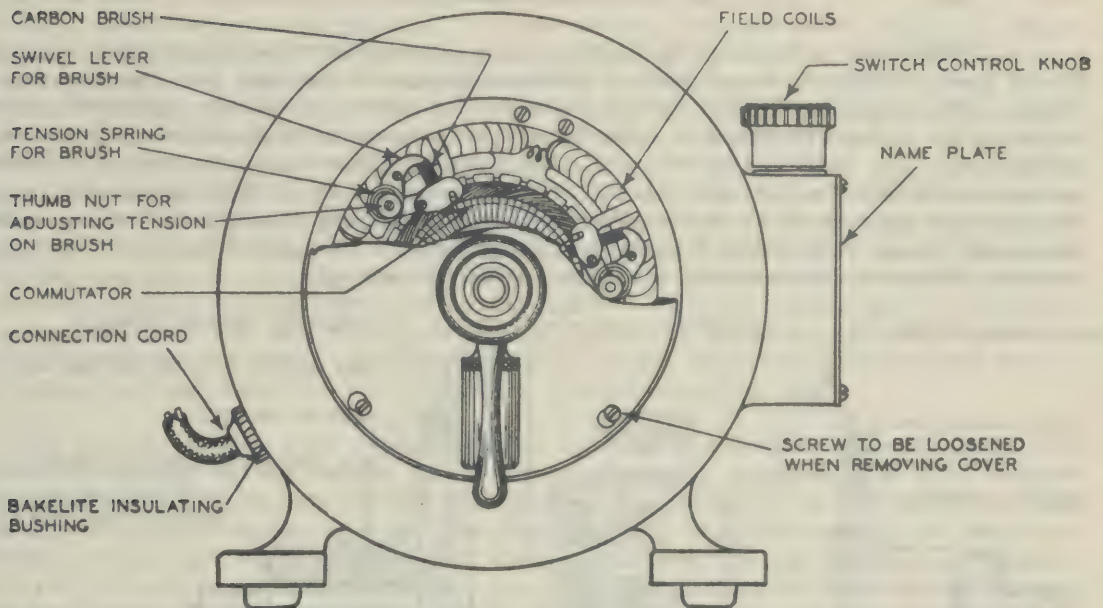


Figure 1

OPERATION

SUPPLY CURRENT - Before attaching this Lathe to an electric outlet, care should be taken to see that the outlet supplies the proper current upon which this Lathe should be operated, as indicated on the name plate. Failure to check this may cause serious harm to the Lathe.

SWITCH - The control switch is located at the front of the Lathe, and is operated by rotating the switch button to the position which gives the desired speed. This Lathe has a speed range of from approximately 1200 to 3200 revolutions per minute, while the switch is so arranged as to allow the operator to select any one of four speeds.

The raised figures on the switch button indicate the different positions, the Lathe running at a speed corresponding to the number which is directly to the front of the switch box. In turning the switch knob it is very important that the knob be turned so that the number desired is always directly to the front. In other words, the switch should not be left in any intermediate position. The correct positions are located as the cam roller drops into a recess in the cam when the stop is correctly made.

CHUCKS - The chucks provided with the Lathe are attached to the spindle by giving them a slight tap. To release them from the spindle, the chuck remover nut is screwed up against the chuck, forcing it off. You will notice that these chucks are marked either "left" or "right" and they should be attached to their respective spindles.

The tapers on the Lathe shaft and the inside of the chucks must at all times be free from any foreign substance, else chucks will not hold on taper.

RITTER DENTAL LATHE

MAINTENANCE

LUBRICATION - This Lathe needs some slight attention at various intervals. Chief among these is supplying it with the proper lubricant for the bearing surfaces. These parts are very easily injured if allowed to operate without lubricant. At regular intervals the oil cups should be inspected and the supply renewed if necessary. In inspecting the oil cups, remove them entirely from the Lathe by grasping the knurled portion of the cup and unscrewing it from its position. The cup portion of the oiler may now be unscrewed exposing the oil filtering washers. Saturate these with Dental Engine oil and return the parts to position, making certain that the felt wick is in contact with the shaft.

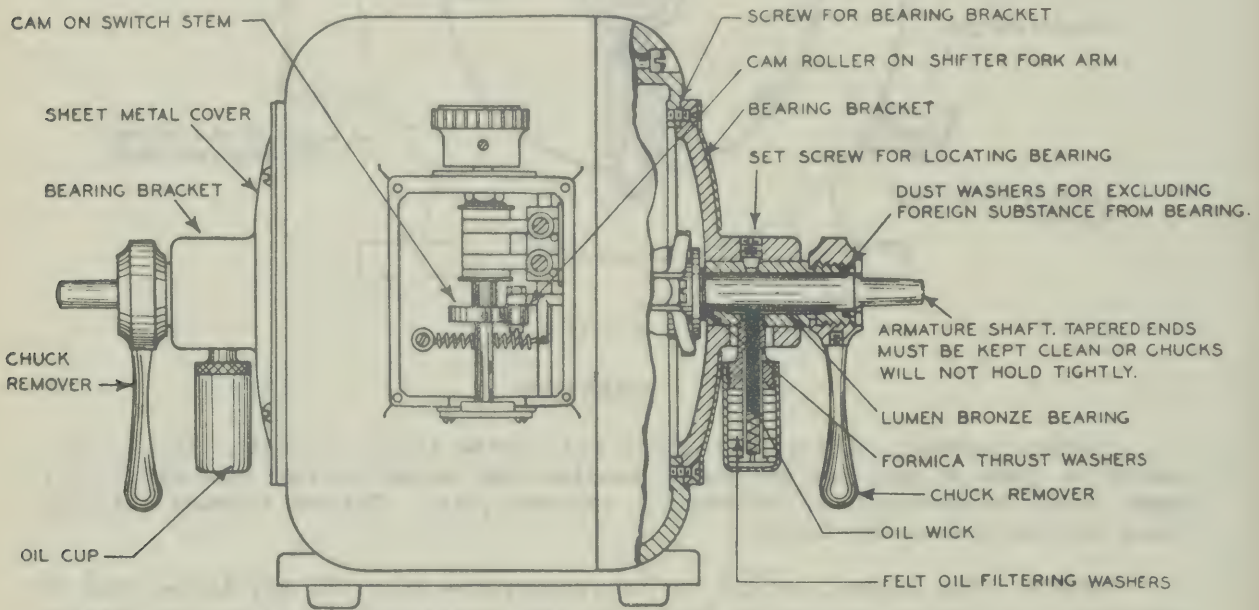


Figure 2

BEARING REPLACEMENT - New bearing bushings may be placed in this Lathe at any time by simply removing the oil cups and unscrewing the tapered set screws which position the bearing, after which the old bearings can be withdrawn and the new ones inserted in their place. In removing the old bushings from the hubs it is necessary to remove from the shaft the washers which are provided to safeguard the bearing against the entrance of foreign substances. These will readily come off the shaft when the bushing is pulled outward. As it is important that the new bushings be properly located in the Lathe, make certain that the bushing stamped "Commutator End" is placed at that end of the Lathe, the commutator end being the left side, looking from the front. Each bushing is provided with a tapered hole for the locating set screw. Line this hole up with the set screw hole and replace the set screw and oil cup, exercising care to see that the oil wick makes contact with the shaft. The dust washers should now be replaced on the shaft; enter the felt washers first, then push on the nicked washers with the aid of a screw driver, working around the washer from side to side. Do not press these washers on so tightly as to eliminate the slight amount of end play allowed the shaft in order that it may revolve freely.

COMMUTATOR BRUSH, ADJUSTMENT AND REPLACEMENT - The brush holder is set at the factory to provide the proper spring tension for the brushes. This adjustment

RITTER DENTAL LATHE

should not be disturbed unless it becomes absolutely necessary. Too great a pressure will wear the brushes rapidly, and not enough tension will result in faulty operation. In the event that it becomes necessary to make an adjustment of the brushes, remove the oil cup and chuck remover nut from the commutator end of the Lathe. The sheet metal cover should next be removed, by loosening the four small screws sufficiently to allow the cover to be rotated so as to bring the large end of the slots in the cover under the screw heads, from which position the cover may be removed, exposing the brush holder to view. It will be noticed that the tension springs are attached to round, knurled nuts and that each of these nuts has a small, blued screw holding it in position. Holding the knurled nut tight, loosen the screw. The round knurled nut is now turned in the direction which will either tighten or loosen the tension spring, whichever is desired. When this round nut is correctly positioned to give the desired adjustment, tighten the blued screw, which locks the tension spring in position. Replace the metal cover, the chuck remover and the oil cup, making certain that the oil wick makes contact with the shaft.

The carbon brushes need replacing only at rare intervals. When a replacement becomes necessary, merely remove the sheet metal cover, exposing the brush holder. If the small swivel arms which hold the brushes in contact with the commutator have advanced so far as to rest against the brush holder, it is necessary to insert new brushes. Merely spring back the small arms and remove the old brushes and replace them with the new brushes. It is well to clean the surface of the commutator upon which the brushes run with a clean cloth. Make certain that the new brushes do not bind in the brush holder, as they must fit freely or the Lathe will not operate properly. Until the new brushes fit themselves to the commutator, they may be noisy. Do not readjust the tension on the brush holders because of this, as it is not necessary to change the adjustment when placing new brushes in the Lathe. Never, under any circumstances, place oil or grease of any kind on the commutator, as the brushes used on this Lathe will not permit this practice.

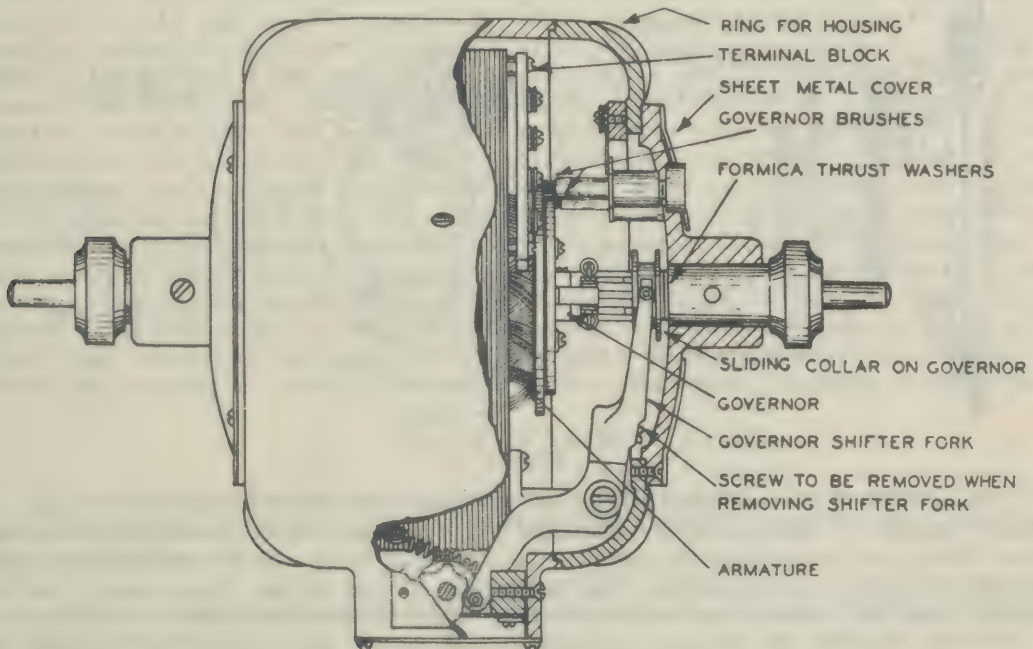


Figure 3

RITTER DENTAL LATHE

GOVERNOR BRUSH REPLACEMENT - When the governor brushes have worn to such an extent that they no longer make contact with the governor plates, they will need to be replaced. Remove the oil cup and sheet metal cover from the governor end of the Lathe. Next remove the four screws which hold on the bearing bracket and remove the bearing bracket. Replace the worn brushes with the new brushes, entering the copper colored ends of the new brushes into the brush holder. Make certain the springs in the brush holder tubes are not lost when making this change. The brushes should be perfectly free to move up and down in the brush holder else they will not operate satisfactorily. It is well to wipe off the plates on the governor where the brushes make contact, and apply a slight amount of oil to these surfaces. Replace the bearing bracket and sheet metal cover. In replacing the oil cup check the contact of the wick against the shaft. Do not neglect to replace the dust washers at the end of the bearing, as these were forced off when the bracket was removed.

GOVERNOR - This Lathe is equipped with a speed controlling governor which will require attention from time to time. To expose the governor to view remove the oil cup and the sheet metal cover from the right side of the Lathe. This gives access to those parts of the governor which require lubrication, these parts being the groove in the sliding collar in which the shifter fork blocks ride, the hub on the governor upon which the sliding collar slides, and the portion of the sliding collar which is in contact with the spring tension bar. Use grease to lubricate these parts, as the high speed at which the armature revolves would throw off oil if it were used. An excessive amount of lubricant should not be used as it would throw off and might cause trouble. When lubricating the governor also remove the name plate and place a small amount of grease on the cam roller.

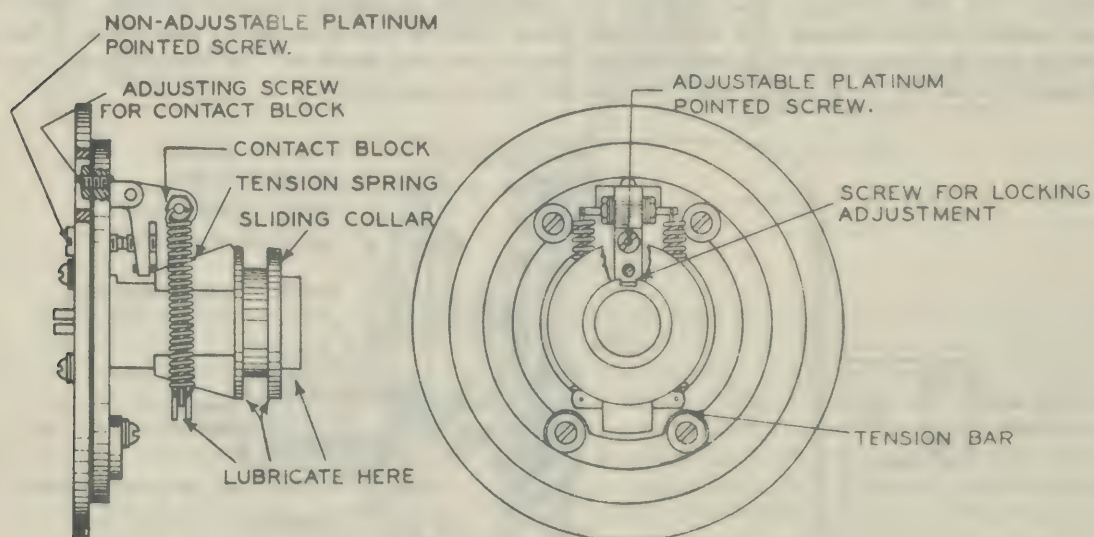


Figure 4

The governor is equipped with two platinum pointed screws which make intermittent contact. These screws will wear out in time and will require replacement. To do this it is necessary to remove the armature from the Lathe. Remove the oil cups and the sheet metal covers from both ends of the Lathe, then remove the carbon brushes from the commutator brush holder. Next remove the four screws which hold the bearing bracket on the governor end of the Lathe and remove the bracket, being careful not to lose the two graphite brushes and springs which are enclosed in the governor brush holders. The screw which fastens the shifter fork to the switch arm should be removed also. Slide the shifter fork toward the governor until it is free of the switch arm from which position it may be removed. The armature is now free

RITTER DENTAL LATHE

to be withdrawn from the Lathe. The governor is pressed on the armature shaft and may be removed by tapping the end of the shaft on a wooden surface until the governor is free. Loosen the locking screw in the contact block and remove the old platinum pointed screws, replacing them by the new ones. The screw with the larger head is nonadjustable and should be screwed through the contact plate until it is drawn down tight against the shoulder. Do not neglect to replace the lock washer under this screw head before assembling the screw to the governor. The other new screw should now be threaded into the contact block. This screw must be adjusted so as to leave a slight gap between the two platinum pointed screws when the contact block is sprung back against the tension of the springs. The proper space at this point is .010 of an inch. The easiest way to make the adjustment is to insert the gauge between the platinum points and then tighten down the adjustable screw in the contact block as far as it will go and then tighten the locking screw to maintain the adjustment. Removing the gauge, inspect the points to see if they make a full surface contact. Should they fail to line up squarely, loosen the lock nut on the contact block adjustment screw and regulate the contact block to a position which will allow the two platinum pointed screws to come together square, then tighten the lock nut on the contact block adjustment screw and regulate the adjustable platinum point to give the necessary clearance.

CAUTION - Make certain that there is always a slight space between the platinum points when the contact block is pulled back against the tension of the springs. This is very important for if the points are held firmly together and cannot separate the Lathe will run at an enormously high rate and will not regulate in speed.

CORD REPLACEMENT - When the connection cord becomes so badly worn as to necessitate replacement, remove the oil cup and sheet metal cover from the governor end of the Lathe, then remove the four screws which hold the housing ring to the housing. Tap the opposite ends of the armature shaft with a wooden block. This will force off the housing ring. The washers on the armature shaft which exclude foreign substances will also be forced off. The connection block is now exposed to view. Loosen the binding post screw at either end of the block and remove the connection cord tips. Unscrew the insulating bushing at the point where the connection cord enters the Lathe. The cord is now free to be removed. Place the bushing on the new cord and insert the cord into the Lathe. In placing the cord tips under the screws on the connection block make certain that none of the other wires running to the block are misplaced. After replacing the housing ring make certain that the governor brushes are making proper contact with the governor. The dust washers should now be replaced on the shaft, enter the felt washers first, then push on the nicked washer with the aid of a screw driver, working around the washer from side to side. Do not press these washers on so tightly as to eliminate the slight amount of end play allowed the shaft in order that it may revolve freely. Check the contact of the oil wick against the shaft when replacing the oil cup.

FAILURE OF LATHE TO START

The following causes may be the source of trouble, should Lathe fail to start when the switch is thrown on. They should be checked over in the order in which they are enumerated.

FIRST - Make certain that the line current at the outlet to which the Lathe is connected is "On".

SECOND - Check cord connections at the plug which is inserted at the outlet. See that both wires are tight.

RITTER DENTAL LATHE

THIRD - Try the Lathe switch in all four positions, giving the armature shaft a turn by hand at the same time.

FOURTH - Check contact of the commutator brushes, cleaning the commutator with a soft cloth should it be dirty. If this doesn't remove all the dirt, polish the commutator with a piece of fine sand paper. Never use emery paper for this purpose. Check contact of the governor brushes.

FIFTH - Check the clearance between the contact screws on the governor, making certain that they have not been worn to such an extent as to no longer make contact.

Any ordinary cause of trouble will be eliminated by following these suggestions. Any correspondence pertaining to this Lathe should give the serial number, type of current and voltage, as indicated on the name plate.

RITTER DENTAL LATHE

MODEL "A" - DIRECT CURRENT

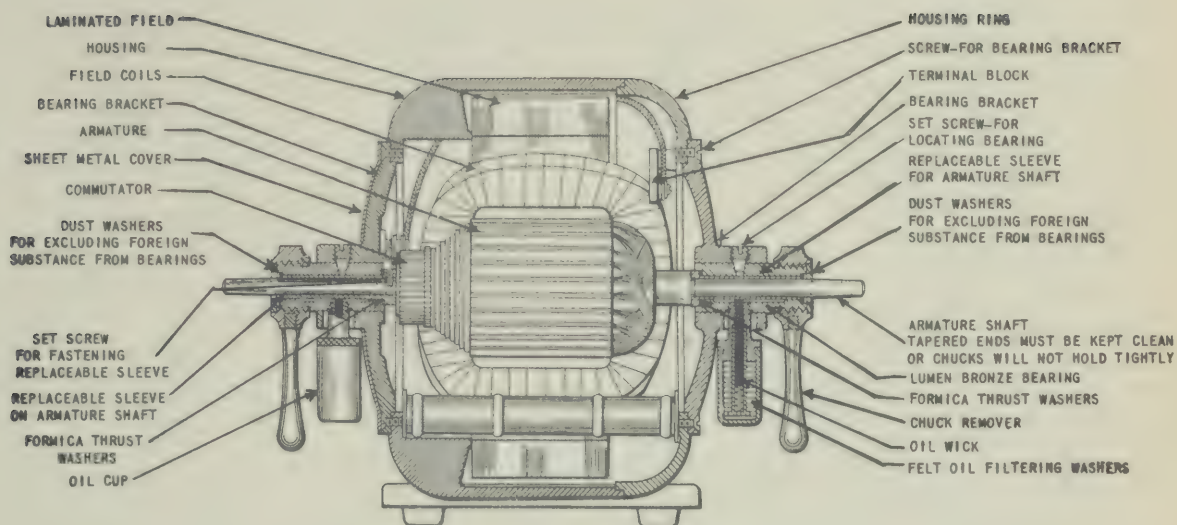


Figure 1

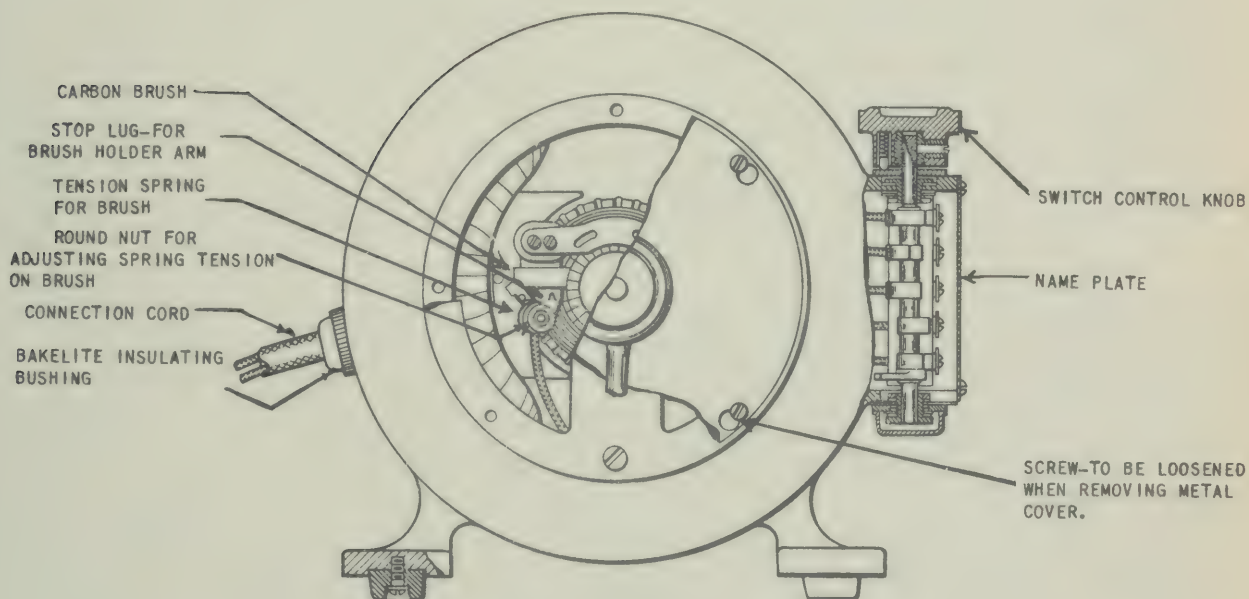


Figure 2

This Lathe has a speed range of from approximately 1000 to 3000 revolutions per minute.

All operating and maintenance factors for the AC lathe apply except, of course, that there is no governor or governor brushes. Due to different field, field coil and armature specifications, and different housing dimensions; the lathe cannot be converted from DC to AC and vice versa.

SECTION LXXII

CASTLE LIGHT

CASTLE LIGHT

INSTALLATION - On Unit: Make sure that the unit has a spotlight adapter.

Slip end of connecting wire with plug on it through the separate upright tube so that plug protrudes through base of tube (i.e. the larger end). Loosen screw at base.

Fit upper end of tube over male bushing at the base of curved bracket section.

Lift entire assembly into position at unit. Push connecting plug into socket on adapter. Make sure that all bushings are seated tightly, and tighten screw.

Be very careful in handling the light that you do not dent the reflector.

Wall Mounting: Bracket may be attached to side or front wall. Lower wall plate should be about 45 in. from floor.

OPERATION - Adjust the light so that its face is 36 to 44 in. in front of the patient's mouth. Turn on switch. Use handle to tilt the lamp head so as to bring the beam up to the mouth. Adjust the beam from bottom to top so as not to throw the beam into patient's eyes. Then without tilting the lamp head further, move the entire lamp assembly forward or backward so that the top of the light beam rests on the tip of the patient's nose.

The nearer the light to the mouth the greater the intensity (as for posterior work) the farther away the less (for anterior).

TO CHANGE TENSION OF LAMP-HEAD IN YOKE - Hex nuts at either side of lamp head yoke control tension on movement of lamp head. Before tightening or loosening these nuts, be sure to "back off" two set screws just back of hex nuts. Tighten these set screws after adjusting hex nuts.

TO CHANGE BULB - Give metal cap at top a slight turn

Use 100 watt SPOTLIGHT bulb 120 volts, "burn base up" type.

GENERAL ROOM ILLUMINATION - Be sure overhead lighting is sufficient. The use of any operating (spot) light requires that there be at least 25 foot candles of light on the bracket table.

CASTLE LIGHT



SECTION LXXIII

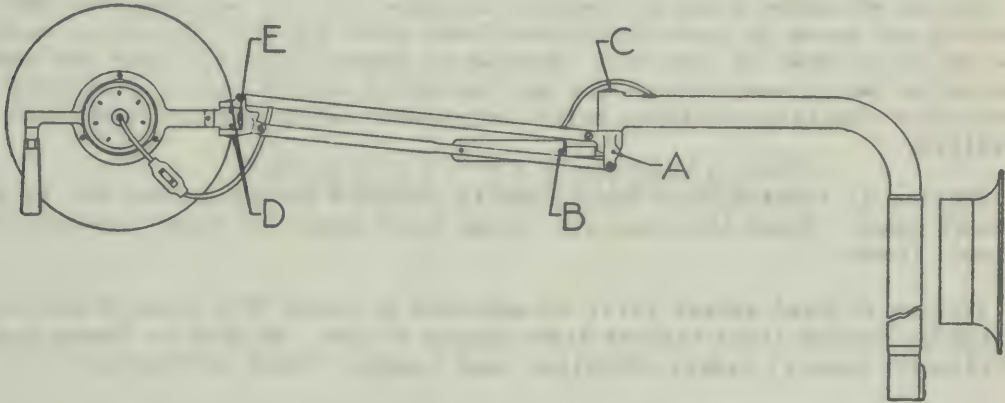
PELTON OPERATING LAMP

PELTON OPERATING LAMP

DIRECTIONS FOR INSTALLING AND OPERATING

UNIT TYPE - Upright column supplied with unit type according to sub-catalogue number is correct length to place light head at proper height on unit equipment for which ordered. Loosen two set screws at bottom of column, mount column on light adapter arm of unit, connecting male plug of electric cord in column to receptacle in unit arm. Mount column with screws to rear and tighten screws firmly. Insert large brass bushing at end of back arm in top of upright column. A drop or two of engine oil on bushing is indicated before lowering all the way into column.

WALL BRACKET TYPE - Wall bracket should be installed on side wall or wall facing chair. In average use the bracket should be mounted with bottom edge 59" from floor. This may be too high or too low in some cases, and may be varied to meet individual requirements. Attaching screws for bracket should enter solid wood for at least 1/2". Before mounting light arm in bracket, make electrical connection and lubricate brass bushing at end of arm as suggested above for unit type.



BULB - Pelton "E & O" Lights are equipped at factory with P-25 100-watt Hard Glass Button Spotlight bulb, designed for *base up* operation. It is recommended that this bulb be used for replacement, although standard P-25 bulb (marked "Burn base down or horizontal") can be used if necessary. Its life, however, is considerably shorter than the "base up" type.

REFLECTOR - This is formed of special aluminum, which retains original reflecting qualities indefinitely. Multi-step design embodies separate reflecting surfaces, each in correct relation to bulb filament. Care should be taken to prevent denting or distorting. Reflector assembly is practically dust-proof, but should be wiped out carefully with a soft cloth once a year. Remove lens bezel and lens for this purpose.

LENS - Specially molded inner surface of lens transforms light rays into horizontally elongated beam pattern. When replacing lens, be sure mold marks run exactly vertical, paralleling large adjusting handle at side of reflector. (Lens on surgical models is stippled finish to produce round beam pattern. It can be installed in any position.)

HEAT AND COLOR FILTER - Inner glass cylinder is color-correcting, heat-absorbing and heat-resisting glass. Cylindrical metal baffle enclosing it on dental models should always be located with cut-out portions at sides.

PELTON OPERATING LAMP

ADJUSTMENTS - The balancing spring used in flexible arm models is specially treated in advance to remove all "set", and seldom requires adjustment. Tension on balancing spring can be changed when desired, proceeding as follows:

With light head in lowest position, drive out pin marked "A" on illustration inside, using small steel drill or nail, and driving pin far enough out to release spring cylinder rod. Drop spring cylinder down and remove two screws "B" which hold spring mechanism inside the cylinder. Then pull out rod which has spring attached. Loosen lock nut on end of rod and then tighten adjusting nut against spring as required (usually one-quarter turn or less). Tighten lock nut again firmly, without disturbing nut. Replace spring in cylinder, lining up holes in plug and cylinder so two screws can be replaced. Then with someone assisting by raising the light head to the suitable point, drive pin first mentioned back through spring cylinder rod and other side of yoke into its original position.

Tension at center joint of flexible arm models can be adjusted when desired by loosening set screw in back of chrome-plated yoke and turning center connecting screw "C" up or down as required. Tension at center joint of rigid arm models is adjusted by two screws through top and bottom of center joint, also held by set screws which should be loosened before adjustment is changed and tightened firmly thereafter.

Tension at front end of front arms is adjusted by two screws "D" in top and bottom of joint. These also have set screws which should be first loosened and then tightened firmly.

Tension on head swivel joint is adjusted by screw "E", head of which may be revealed by turning light head at right angles to arm. Be sure to loosen set screw (in reflector holder) before adjusting, and tighten firmly afterward.

MAINTENANCE SUGGESTIONS - Pelton Lights are finished in a urea base plastic finish. Should luster be dimmed by dirt film, simply polish with any well-known preparation. Chrome-plated parts should occasionally be cleaned with any good silver cream. Always use clean, soft cloths for polishing and cleaning - preferably cheesecloth.

The center joint, front arm joint and head swivel joint of all models should be lubricated occasionally with a drop or so of engine oil.

SECTION LXXIV

DENTAL HANDPIECE

TECHNICAL MANUAL
NO. 8-

WAR DEPARTMENT,
Washington,

DENTAL HANDPIECES

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DENTAL HANDPIECES

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DENTAL HANDPIECE TEXT

EXPLANATION

The following is a reproduction of the original preparation of the material to be distributed as a Training Manual. This preparation was made by the Manual and Spare Parts Branch of the Maintenance Division of the St. Louis Medical Depot.

Identification numbers of parts are those which will be found in the new Medical Department Section of the ASF Catalogue. The numbers will be used in obtaining parts for replacement where the supply of parts is not automatic distribution. It is important to identify handpieces in question as to manufacturer as all parts are not interchangeable and are therefore assigned different part numbers.

PART ONE

INTRODUCTION

SECTION 1 - GENERAL.

1. Scope.

a. These instructions are published for the information and guidance of all personnel to whom these items are supplied. They contain information on the operation and maintenance of the items. The instructions apply only to Medical Department Items No. 5261005 Engine, Handpiece, Angle, and No. 5263005 Engine, Handpiece, Straight. They are arranged in three parts: Part One - Introduction; Part Two - Operating Instructions; Part Three - Maintenance Instructions.

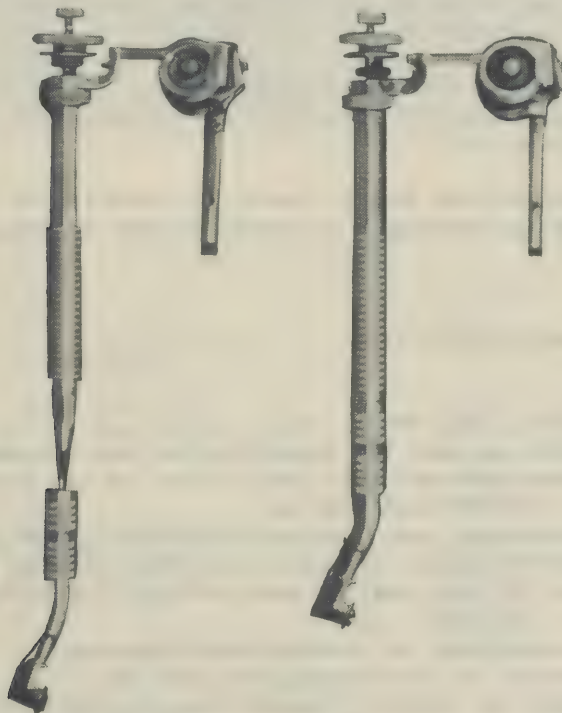


FIGURE NO. 1

Engine, Handpiece, Straight and Engine, Handpiece, Angle

DENTAL HANDPIECES

b. Illustrations concerning the various phases of operation and maintenance are included in the manual. Standard Nomenclature Lists for each item are appended.

SECTION 2 - DESCRIPTION.

2. Engine, Handpiece, Straight.--The Engine, Handpiece, Straight is a device for holding and rotating dental burs and other attachments used in cavity preparation and the cutting and polishing of teeth.

3. Engine, Handpiece, Angle.--The Engine, Handpiece, Angle, is a device used to hold and rotate dental burs and other attachments. It is attached to the Engine, Handpiece, Straight for the purpose of reaching and working at cavities which cannot be reached readily with the Engine, Handpiece, Straight.

4. First and Second Echelon Repair Tools.--The following tools are necessary to the first and second echelons of maintenance.

a. Common Tools:

- (1) Small screw driver for wrist joint screws.
- (2) Light hammer for rivets.
- (3) Wire cutters for cutting rivets.
- (4) Small file for rivets.
- (5) Pliers.
- (6) Small vise.

b. Uncommon Tools:

- (1) 5R00802 Cleaning and adjusting plate for bur latch slot.
- (2) 5R00804 Dental screw driver for bur latch and pulley screws.
- (3) 5R00806 Spindle wrench.
- (4) 5R00808 Chuck removal rod.
- (5) 5R00810 Punch for removing rivets.
- (6) 5R00812 Wood clamps for disassembly and assembly of angles.
- (7) 5R00814 Lapping pin.

5. Fourth and Fifth Echelon Repair Tools.--In addition to the tools listed in paragraph 4, the following tools are necessary to the fourth and fifth echelons of maintenance:

a. Common Tools:

- (1) Pencil type soldering iron.

b. Uncommon tools:

- (1) 5R00816 Holding tool for the head.
- (2) 5R00818 Soldering tool for inserting the back bearing into the head.
- (3) 5R00820 Reamer for the left hand thread of the head in preparing for replacement of the back bearing.
- (4) 5R00824 Replacement tool for replacing rivets, shafts, and gears.
- (5) 5R00826 Bottom reamer for reaming bottom of head in preparation for replacement of back bearing and removal of excess solder after back bearing is inserted.
- (6) 5R00828 Removal tool for removing back bearing.
- (7) 5R00830 Holding pin for tinning back bearing.
- (8) 5R00832 Punch for removal of gears from shafts.
- (9) 5R00834 Punch A for first step in removing corroded shaft.
- (10) 5R00836 Punch B for second step in removing corroded shaft.

DENTAL HANDPIECES

Tools for Repair of Engine, Handpiece, Straight and Engine, Handpiece, Angle
FIGURE 2



A REPRESENTATIVE SET OF DENTAL HANDPIECE REPAIR TOOLS
KEY TO FIGURE 2

Med. Dept. No.	Nomenclature	Med. Dept. No.	Nomenclature
<u>COMMON TOOLS</u>			
1.	LIGHT HAMMER FOR RIVETS:	12.	5R00830 PIN, HOLDING:
2.	WIRE CUTTERS FOR CUTTING RIVETS:	13.	5R00828 REMOVAL TOOL:
3.	PLIERS:	14.	5R00826 REAMER, BOTTOM:
4.	SMALL VISE:	15.	5R00824 REPLACEMENT TOOL:
5.	PENCIL TYPE SOLDERING IRON:	16.	5R00820 REAMER, HEAD, LEFT HAND
6.	SMALL FILE FOR RIVETS:	17.	5R00818 SOLDERING TOOL:
7.	SMALL SCREW DRIVER FOR WRIST JOINT SCREWS:	18.	5R00816 HOLDING TOOL, HEAD:
		19.	5R00812 CLAMP, WOOD:
		20.	5R00808 ROD, CHUCK REMOVAL:
		21.	5R00806 WRENCH, SPINDLE:
		22.	SPECIAL WRENCH FOR CHAYES
			STRAIGHT HANDPIECE:
			SPECIAL WRENCH FOR CHAYES
			ANGLE HANDPIECE:
		24.	5R00804 SCREW DRIVER, DENTAL, BUR
			LATCH AND PULLEY SCREW:
<u>UNCOMMON TOOLS</u>			
8.	5R00814 PIN, LAPPING:		
9.	5R00810 PUNCH, RIVET REMOVING:		
10.	5R00802 PLATE, CLEANING AND		
	ADJUSTING:		
11.	5R00832 PUNCH, GEAR REMOVAL:		

DENTAL HANDPIECES
PART TWO-A
OPERATING INSTRUCTIONS
ENGINE, HANDPIECE, STRAIGHT

SECTION 1 - GENERAL.

6. Scope.--Part Two-A contains information on the unpacking and mechanical operation of the Engine, Handpiece, Straight.

SECTION 2 - SERVICE UPON RECEIPT OF EQUIPMENT.

7. Unpacking.--To unpack the Engine, Handpiece, Straight, remove it from the container in which it is shipped. The instrument is shipped completely assembled and is ready to be put into immediate use and operation.

SECTION 3 - OPERATION.

8. Attaching to dental engine forearm.--To attach the Engine, Handpiece, Straight to the dental engine, insert the end of the engine arm into the rear swivel arm, 5R00754 (fig. 3), of the straight handpiece. Push the latch, 5R00716 (fig. 3), out by thumb nail pressure on the latch pin, 5R00720 (fig. 3), far enough to permit the engine arm to be inserted. Completely relieve pressure on latch pin and rotate until the latch snaps into notch on the engine arm. Finally, slip the engine belt over the drive pulley, 5R00744 (fig. 3), and the two wrist joint pulleys, 5R00708 (fig. 3). On placing over wrist joint pulleys, it is not necessary to remove pulley guard, 5R00712 (fig. 3), but the cord is forced between the wrist joint pulleys and the guard. Care must be exercised to place the drive belt on the desired sheave of the dental motor drive pulley which has two belt grooves provided. Use of the larger groove provides maximum handpiece speed, while the smaller provides half of that speed. The foot controller of the motor further provides for four degrees of both forward and reverse speed.

9. Inserting the bur.--Loosen tightening rod, 5R00706 (fig.3), at least two full turns and insert the rear end of the bur selected as far as it will go into the nose of handpiece. Then hold the drive pulley, 5R00744 (fig. 3), with one hand and turn the tightening rod clockwise with the other hand until it is tight. The bur is now locked in position.

10. Adjustments necessary to proper functioning of handpieces.

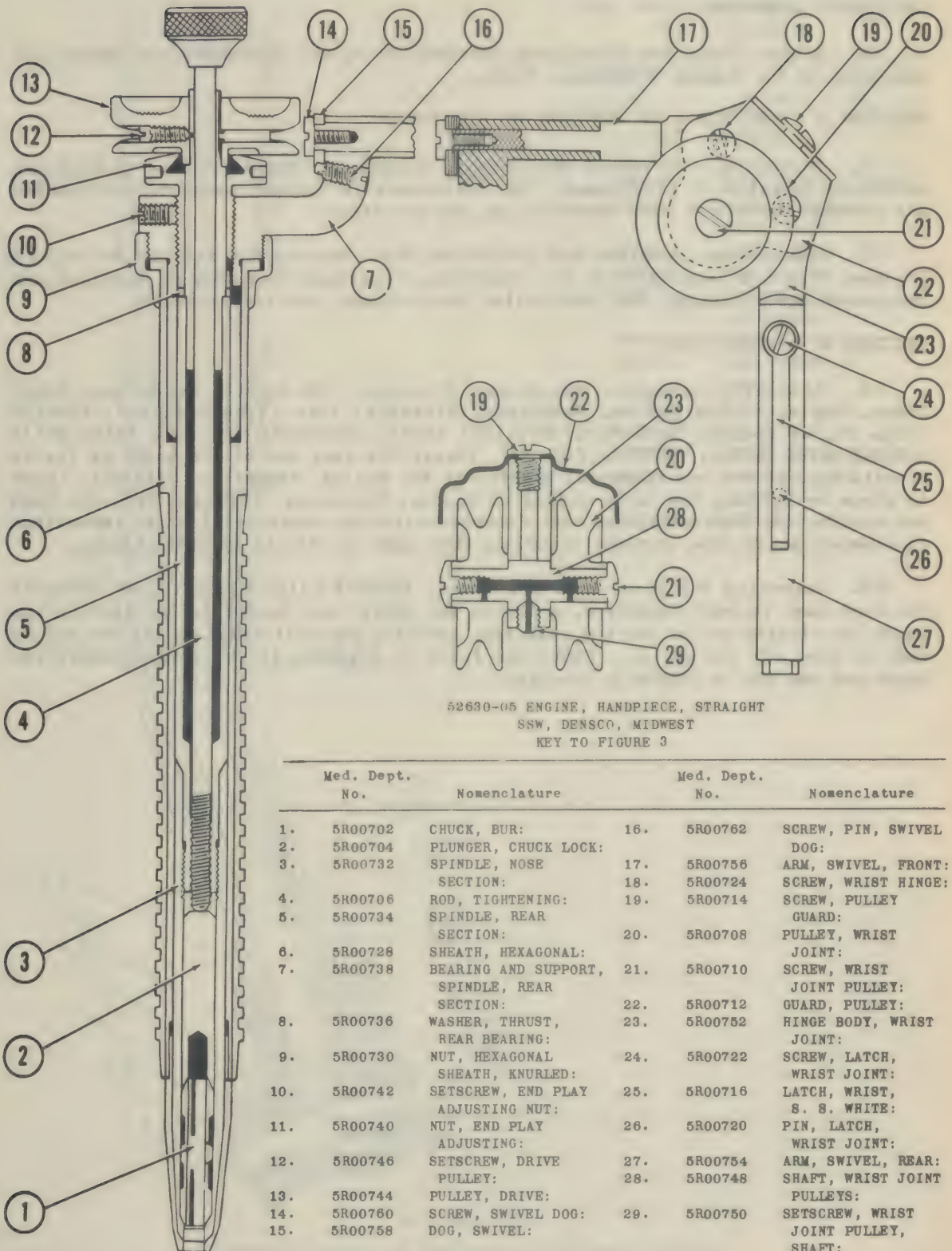
a. Engine belt must be adjusted for proper tension to provide maximum power drive of drive pulley, 5R00744 (fig. 3). The adjustment should be made daily as atmospheric moisture changes will affect belt length. The tension of belt should be relieved after each daily operating period to prevent undue stretching of belt. A loosely adjusted belt will deliver more power than a tight belt which will skid in the drive pulley groove.

b. Drive pulley must be clean and free of foreign bulk which will cause bur to pound as belt passes over bulk.

c. Belt must be free of lumps or worn spots which also cause pounding.

DENTAL HANDPIECES

Cross Section of Engine, Handpiece, Straight
FIGURE NO. 3



52630-05 ENGINE, HANDPIECE, STRAIGHT
SSW, DENSCO, MIDWEST
KEY TO FIGURE 3

Med. Dept. No.	Nomenclature	Med. Dept. No.	Nomenclature
1.	5R00702 CHUCK, BUR:	16.	5R00762 SCREW, PIN, SWIVEL
2.	5R00704 PLUNGER, CHUCK LOCK:		DOG:
3.	5R00732 SPINDLE, NOSE	17.	5R00756 ARM, SWIVEL, FRONT:
	SECTION:	18.	5R00724 SCREW, WRIST HINGE:
4.	5R00706 ROD, TIGHTENING:	19.	5R00714 SCREW, PULLEY
5.	5R00734 SPINDLE, REAR		GUARD:
	SECTION:	20.	5R00708 PULLEY, WRIST
6.	5R00728 SHEATH, HEXAGONAL:		JOINT:
7.	5R00738 BEARING AND SUPPORT, SPINDLE, REAR	21.	5R00710 SCREW, WRIST
	SECTION:		JOINT PULLEY:
8.	5R00736 WASHER, THRUST, REAR BEARING:	22.	5R00712 GUARD, PULLEY:
9.	5R00730 NUT, HEXAGONAL SHEATH, KNURLED:	23.	5R00752 HINGE BODY, WRIST
10.	5R00742 SETSCREW, END PLAY ADJUSTING NUT:		JOINT:
11.	5R00740 NUT, END PLAY ADJUSTING:	24.	5R00722 SCREW, LATCH, WRIST JOINT:
12.	5R00746 SETSCREW, DRIVE PULLEY:	25.	5R00716 LATCH, WRIST, S. S. WHITE:
13.	5R00744 PULLEY, DRIVE:	26.	5R00720 PIN, LATCH, WRIST JOINT:
14.	5R00760 SCREW, SWIVEL DOG:	27.	5R00754 ARM, SWIVEL, REAR:
15.	5R00758 DOG, SWIVEL:	28.	5R00748 SHAFT, WRIST JOINT PULLEYS:
		29.	5R00750 SETSCREW, WRIST JOINT PULLEY, SHAFT:

DENTAL HANDPIECES
PART TWO-B
OPERATING INSTRUCTIONS
ENGINE, HANDPIECE, ANGLE

SECTION 1 - GENERAL.

11. Scope.--Part Two-B contains information on the unpacking and mechanical operation of the Engine, Handpiece, Angle.

SECTION 2 - SERVICE UPON RECEIPT OF EQUIPMENT.

12. Unpacking.--To unpack the Engine, Handpiece, Angle, remove it from the container in which it is shipped. The instrument is shipped completely assembled and is ready to be put into immediate use and operation.

13. Lubrication.--Angles are lubricated when leaving the factory but may be dry when they are received. It is, therefore, important that they be examined and lubricated before using. For lubrication instructions, see paragraph 35.

SECTION 3 - OPERATION.

14. Attaching to Engine, Handpiece, Straight.--To attach the Engine, Handpiece, Angle, to the Engine, Handpiece, Straight, turn tightening rod, 5R00706 (fig. 3), of Engine, Handpiece, Straight counterclockwise two full turns while holding drive pulley, 5R00744 (fig. 3). Insert the rear end of the Angle as far as it will go onto the end hexagonal adapter of the Engine, Handpiece, Straight. Lock in place by holding the drive pulley of Engine, Handpiece, Straight with one hand and turning the tightening rod nut clockwise with the other until it is impossible to separate angle from straight handpiece when each is held in opposite hands.

15. Inserting the bur.--Open the latch, 5R00618 (fig. 4), with the thumb of the hand used to hold handpiece, and with the other hand insert fully into the bur chuck the slotted end of the bur selected, rotating the half-round end of the bur so that it goes all the way in. Close the latch by snapping to the straight position again and the bur is locked in position.

DENTAL HANDPIECES

ITEM 52610-05 ENGINE, HANDPIECE, ANGLE
SSW, DENSCO, CLEV-DENT, MIDWEST
KEY TO FIGURE 4

Med. Dept.		
	No.	Nomenclature
1.	5R00606	BURTUBE:
2.	5R00608	CAP:
3.	5R00612	GEAR, SHAFT TO HEAD:
4.	5R00624	BEARING HOUSING, GEAR SHAFT:
5.	5R00616	RIVET, BRASS:
6.	5R00626	KNEE HOUSING:
7.	5R00630	ADAPTER, END HEXAGONAL:
8.	5R00632	SHAFT, DRIVE:
9.	5R00614	GEAR, SHAFT TO SHAFT:
10.	5R00622	SHAFT:
11.	5R00618	LATCH, BUR:
12.	5R00620	SCREW, BUR LATCH:
13.	5R00610	BEARING, SMALL, HEAD:
14.	5R00604	HEAD HOUSING:

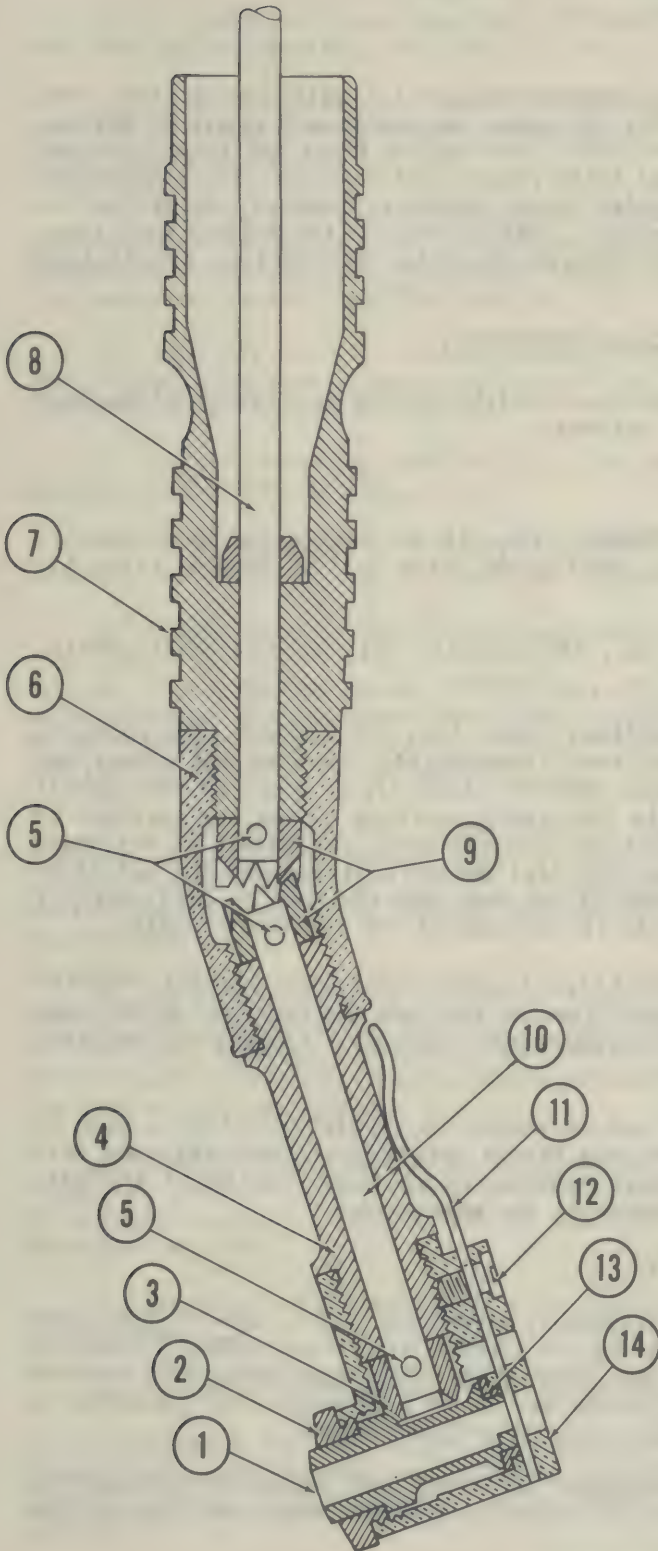


FIGURE NO. 4
Cross Section of Engine, Handpiece, Angle

DENTAL HANDPIECES
PART THREE-A
MAINTENANCE INSTRUCTIONS
ENGINE, HANDPIECE, STRAIGHT

SECTION 1 - GENERAL.

16. Scope.--Part Three-A contains information for the guidance of using and maintenance organizations responsible for the proper operation and repair of Engine, Handpiece, Straight. It is broken down into a section for first and second echelon maintenance and a section for fourth and fifth echelon maintenance. The maintenance authorized for the various echelons under these sections, however, should not be construed as binding. They are a guide only. Maintenance of the Engine, Handpiece, Straight, should be carried on as far forward as parts, facilities, and trained dental repair personnel are available.

SECTION 2 - FIRST AND SECOND ECHELON MAINTENANCE.

17. Cleaning.--The Engine, Handpiece, Straight should be cleaned after each 10 hours of general operative usage as follows:

a. Disassemble.

- (1) Remove tightening rod, 5R00706 (fig. 3), by unscrewing in a counter-clockwise direction while holding the drive pulley, 5R00744 (fig. 3), stationary.
- (2) Remove hexagonal sheath nut, 5R00730 (fig. 3), and hexagonal sheath, 5R00728 (fig. 3).
- (3) Mark the two spindle sections where they are joined as a guide to their proper relationship when reassembled. Unscrew and remove the nose section of the spindle, 5R00732 (fig. 3), by means of two special handpiece wrenches used in flat spots provided on the two sections of the spindle. Do not, under any circumstances, use pliers or any undue force, as alignment of spindle sections is delicate and the relationship of the bearing surface of the nose section must be maintained as machined, to fit the inside of the nose of the hexagonal sheath.
- (4) Remove bur chuck, 5R00702 (fig. 3), and chuck lock plunger, 5R00704 (fig. 3), by inserting chuck removal rod into the nose end of the nose section and forcing the bur chuck and chuck lock plunger out the rear end of the nose section.

b. Clean by immersing parts in any conveniently available solvent, such as kerosene. Clean spindle, inserting one end into a syringe bulb and other end into solvent, compressing bulb several times vigorously to flush inside of spindle. Sheath, 5R00728 (fig. 3), should be cleaned in the same manner.

c. Lubricate. (See paragraph 19).

d. Reassemble by reversing the disassembly procedure, being sure to place open end of chuck lock plunger, 5R00704 (fig. 3), in contact with chuck, 5R00702 (fig. 3). Chuck itself will function end for end. Tamp these home separately with removal tool before uniting spindle sections which are to be tightened with wrenches to established scratch line as described in c (3) of this paragraph.

18. Adjusting.--It is sometimes necessary to adjust the spindle in relation to the hexagonal sheath, 5R00728 (fig. 3), in order to prevent undue end play of the bur. To adjust, proceed as follows:

DENTAL HANDPIECES

a. Be positive sheath hex nut, 5R00730 (fig. 3), is fully tight against spindle rear section bearing, 5R00738 (fig. 3).

b. Back off setscrew, 5R00742 (fig. 3), in the spindle rear section bearing and support piece, 5R00738 (fig. 3), until the end play adjusting nut, 5R00740 (fig. 3), turns freely.

c. Turn the end play adjusting nut clockwise by inserting broken bur shank in hole occurring in two places in knurled surface until it stops, indicating that the spindle has moved forward far enough to make contact with the inside of the nose of the hexagonal sheath, 5R00728 (fig. 3).

d. Back off end play adjusting nut, 5R00740 (fig. 3), 1/16th of a turn to provide proper clearance between the nose of the spindle and the inside of the nose of hexagonal sheath, 5R00728 (fig. 3).

e. Tighten setscrew, 5R00742 (fig. 3), in the spindle rear section bearing and support piece, 5R00738 (fig. 3).

19. Lubricating.--The Engine, Handpiece, Straight, should be lubricated once for each ten hours of general operative usage as follows:

a. Disassemble as described in paragraph 17a.

b. Cover the bur chuck, 5R00702 (fig. 3), lightly with engine handpiece lubricating grease, Medical Department Item No. 5262700, and replace in the nose section of the spindle, 5R00732 (fig. 3). Replace the chuck lock plunger, 5R00704 (fig. 3), and the nose section of the spindle.

c. Cover rear section of the spindle, 5R00734 (fig. 3), with lubricant by inserting lubricant in spindle rear section bearing hole which is revealed when hexagonal sheath, 5R00728 (fig. 3), is removed. Lubricate by holding spindle horizontal and holding drive pulley, 5R00744 (fig. 3), as close as possible to rear section bearing.

d. Lubricate the nose section of spindle, 5R00732 (fig. 3), only, as it is in contact with the inside of the nose of the hexagonal sheath, 5R00728 (fig. 3), which is the front bearing. Slightly lubricate outside of rear section bearing, over which sheath is placed. Remove tightening rod, 5R00706 (fig. 3), lightly lubricate threaded end, then replace.

e. Weekly disassemble wrist joint pulley, 5R00708 (fig. 3), and guard, 5R00712 (fig. 3). Immerse pulley shaft, 5R00748 (fig. 3), and hinge body, 5R00752 (fig. 3), in solvent, wipe off, and lubricate pulley shaft and hinge actions lightly with dental engine oil.

20. Inability to insert bur into chuck.--To correct this condition, proceed as follows:

a. Disassemble as described in paragraph 17a.

b. Enlarge the hole in the bur chuck, 5R00702 (fig. 3), by inserting a tapered broken instrument handle in the chuck and spreading the holding prongs slightly. Use care not to spread too much, since chuck must fit into the nose section of the spindle.

DENTAL HANDPIECES

c. Check by inserting a bur to determine whether the hole is large enough to receive the bur.

d. Lubricate and assemble.--Excessive use of lubricant will cause chuck, 5R00702 (fig. 3), to slip. Failure to relate properly the open end of the chuck lock plunger, 5R00704 (fig. 3), with relation to chuck will prevent chuck from locking. Examine chuck minutely for cracked or broken prongs. If prongs have lost temper, replace chuck.

21. Failure of chuck to hold bur.--Failure of chuck, 5R00702 (fig. 3), to hold bur is caused by a cracking or flared out member due to excessive tightening rod pressure on chuck lock plunger, 5R00704 (fig. 3), at open end. No repair is possible. Examine minutely and replace when indicated.

22. Loosening of the knurled head on the tightening rod, 5R00706 (fig. 3).--Occasionally the knurled head becomes loose from the shaft to which it is attached. When such a condition exists, correct by proceeding as follows:

a. Separate shaft from nut.

b. Using a laboratory bunsen burner for heat, tin the tip of the shaft and drop a couple small pieces of solder into the hole in the knurled nut.

c. Holding the nut with pliers and grasping the shaft on the threaded end, insert the opposite end of the shaft into the knurled nut. Hold over the flame until the solder in the nut has melted, and the shaft has been inserted as far as it will go.

d. Permit the piece to cool.

23. Replacing worn main belt drive pulley, 5R00744 (fig. 3).--When the action of the belt has rounded the V-Channel in the drive pulley, the drive pulley should be replaced. To replace the drive pulley, proceed as follows:

a. Remove the setscrew, 5R00746 (fig. 3), in the V-Channel of the drive pulley by turning it counterclockwise.

b. Lift the drive pulley off the shaft to which it is attached.

c. Place the new drive pulley on the shaft with the V-Channel edge toward the nose end of the handpiece. Make sure the pin in the drive pulley enters the key-way in the shaft, otherwise the pulley will not go on. Rotate the drive pulley on the shaft to find the proper position.

d. Insert the setscrew in the new drive pulley and turn clockwise until tight. This locks the drive pulley on the spindle shaft.

e. Occasionally the drive pulley will rotate without the motion being transferred to the bur. Such a condition indicates a loose or missing drive pulley setscrew, 5R00746 (fig. 3). Tighten or supply the setscrew to remedy the condition.

24. Tightening the locking latch screw, 5R00722 (fig. 3).--The locking latch screw occasionally works loose and must be tightened by turning clockwise until tight.

DENTAL HANDPIECES

25. Worn locking latch, 5R00716 (fig. 3).--Remove latch screw, 5R00722 (fig. 3), and replace latch, being careful not to lose pin, 5R00720 (fig. 3), used to disengage latch.

26. Adjusting for wear of hinge assembly.--Remove pulley guard, 5R00712 (fig. 3), and pulley, 5R00708 (fig. 3). Tighten the two sets of male and female screws revealed, but allow freedom of hinge action.

27. Replacing wrist joint pulley parts.

a. Replacing pulley guard, 5R00712 (fig. 3).

- (1) Remove pulley guard screw, 5R00714 (fig. 3), by turning counter-clockwise.
- (2) Lift off pulley guard.
- (3) Put new pulley guard in position.
- (4) Insert pulley guard screw and tighten by turning clockwise.

b. Replacing wrist joint pulley, 5R00708 (fig. 3).

- (1) Remove pulley guard as described in paragraph 27a.
- (2) Remove pulley screw, 5R00710 (fig. 3), of defective pulley by turning counterclockwise.
- (3) Replace with new wrist joint pulley.
- (4) Replace wrist joint pulley screw and tighten by turning clockwise. Replace pulley guard.

SECTION 3 - FOURTH AND FIFTH ECHELON MAINTENANCE.

28. General.--In addition to the maintenance outlined in Section 2 for the first and second echelons, fourth and fifth echelons are authorized to effect the following repairs.

29. Replacing rear swivel arm, 5R00754 (fig. 3).

a. Remove wrist joint pulley guard and wrist joint pulleys as described in paragraph 27.

b. This procedure reveals two wrist hinge screws, 5R00724 (fig. 3). Remove the one for the rear swivel arm by turning counterclockwise while holding hinge screw nut with a second screw driver from opposite side of hinge.

c. Replace worn rear swivel arm, 5R00754 (fig. 3), and wrist hinge screw, 5R00724 (fig. 3), and nut.

d. Replace wrist joint pulleys, 5R00708 (fig. 3), and pulley guard, 5R00712 (fig. 3).

DENTAL HANDPIECES

30. Replacing front swivel arm, 5R00756 (fig. 3).

a. Proceed as for replacing rear swivel arm described in paragraph 29, but remove the wrist hinge screw, 5R00724 (fig. 3), and nut which holds the front swivel arm.

b. Remove the tightening rod, 5R00706 (fig. 3), and drive pulley, 5R00744 (fig. 3). This permits removal of the swivel dog screw, 5R00760 (fig. 3) and the swivel dog, 5R00758 (fig. 3), and front swivel arm.

c. Replace front swivel arm.

d. Reassemble by reverse procedure.

31. Replacing end play adjusting nut, 5R00740 (fig. 3).

a. Remove tightening rod, 5R00706 (fig. 3), and drive pulley, 5R00744 (fig. 3).

b. Loosen end play adjusting nut setscrew, 5R00742 (fig. 3), in front of spindle rear section bearing and support, 5R00738 (fig. 3).

c. Remove end play adjusting nut by turning counterclockwise.

d. Replace defective end play adjusting nut by reversing procedure outlined above.

32. Conversion of round nose sheath.--Replace nose and rear sections of spindle and sheath as a set as provided by manufacturer. New sheaths will be of hexagon type.

DENTAL HANDPIECES
PART THREE-B
MAINTENANCE INSTRUCTIONS
ENGINE, HANDPIECE, ANGLE

SECTION 1 - GENERAL.

33. Scope.--Part Three-A contains information for the guidance of using and maintenance organizations responsible for the proper operation and repair of Engine, Handpiece, Angle. It is broken down into a section for first and second echelon maintenance and a section for fourth and fifth echelon maintenance. The maintenance procedures authorized for the various echelons under these sections, however, should not be construed as binding. They are a guide only. Maintenance of the Engine, Handpiece, Angle, should be carried on as far forward as parts, facilities, and trained dental repair personnel are available.

SECTION 2 - FIRST AND SECOND ECHELON MAINTENANCE.

34. Cleaning.--The Engine, Handpiece, Angle, should be cleaned after each 10 hours of general operative usage as follows:

a. Disassemble.

- (1) Remove bur latch, 5R00618 (fig. 4), by removing bur latch screw, 5R00620 (fig. 4).
- (2) Remove head assembly by gripping with wooden clamp or plier jaws padded with friction tape to protect handpiece plated finish, and unscrewing while gripping adjoining bearing assembly with a similar tool. While holding head with clamp, remove head cap, 5R00608 (fig. 4), by unscrewing to left, using pliers. Remove burtube, 5R00606 (fig. 4).
- (3) Remove bearing section, 5R00624 (fig. 4), from elbow section, 5R00626 (fig. 4), in similar manner.
- (4) Remove elbow section from rear bearing section in a similar manner.

b. Clean by immersing and agitating for 10 minutes or more in any conveniently available solvent, such as kerosene. Clean bur latch slot by passing front end of latch, 5R00618 (fig. 4), through slot from end to end. Clean lubricating holes in elbow, 5R00626 (fig. 4), and head, 5R00604 (fig. 4), by inserting a broken tapered bur shank. Clean gears with a dental wire scratch brush, using solvent freely.

c. Lubricate as explained in paragraph 35.

d. Reassemble by reversing disassembly procedure, exercising care in use of tools to prevent marring the plated finish. It is important that knurled end of bearing section, 5R00624 (fig. 4), adjoin head, 5R00604 (fig. 4), and that head be properly related to the elbow, 5R00626 (fig. 4). Aligning lubrication holes in elbow and head will assure proper relationship. To secure proper relationship, the use of either .003 or .005 spacing washers or both, between one or more of the component sections may be required as indicated by trial procedure. If spacing washers have previously been employed, replace them as previously used to expedite the assembly. Upon completing assembly, test with bur by drilling a piece of brass or similar metal.

35. Lubrication.--Lubricate once for each 5 hours of general operative usage as follows:

DENTAL HANDPIECES

a. Using Engine, Handpiece, Lubricating Grease, Medical Department Item No. 5262700, insert tip of tube into hole in elbow, 5R00626 (fig. 4), and squeeze tube to pack grease into elbow until it begins to escape at junction of tube tip and hole.

b. Open bur locking latch, 5R00618 (fig. 4), which blocks hole in the closed position and repeat as in a at hole in head.

c. When Engine, Handpiece, Angle, is disassembled for cleaning, it is preferable to lubricate by packing grease into the elbow and the head assemblies as the component sections are reassembled. This will eliminate air pockets that may occur if lubrication is performed as in a and b.

36. Difficulty in opening or closing bur latch, 5R00618 (fig. 4).--To correct, proceed as follows:

a. Remove latch by unscrewing bur latch screw, 5R00620 (fig. 4).

b. Pass flat end of latch through latch slot, end for end. If tight, enlarge slot by spreading with thin screw driver blade at points of constriction or by using adjusting plate tool driven into slot with hammer.

c. Reassemble and adjust tension of latch by bending with pliers so that comfortable thumb pressure is needed to snap the latch over the bearing housing, 5R00624 (fig. 4).

37. Failure of bur to revolve.--To eliminate this condition, proceed as follows:

a. While holding Engine, Handpiece, Angle, in one hand, rotate rear drive shaft, 5R00632 (fig. 4), with thumb and forefinger of other hand. If burtube, 5R00606 (fig. 4), revolves, the chuck, 5R00702 (fig. 3), of the Engine, Handpiece, Straight, is not properly gripping rear drive shaft. Adjust or replace chuck of Engine, Handpiece, Straight.

b. If burtube, 5R00606 (fig. 4), does not revolve, remove burtube cap, 5R00608 (fig. 4), and remove any spacing washer that may be under it, as gear on burtube may have become worn and will not engage drive gear if such a spacing washer is used. Inspect burtube ring gear for separation of soldered joint with burtube. If broken, resolder or replace burtube completely.

c. If b does not correct condition, remove head as in 34a. Repeat test, observing rotation of front gear, 5R00612 (fig. 4), of bearing section. If gear revolves, the fault is in the head assembly. Replace head assembly from spare parts stock, using latch, 5R00618 (fig. 4), and latch screw, 5R00620 (fig. 4), from defective head. When head is replaced, it is generally indicated that front gear of bearing section be replaced. Reassemble as in 34d.

d. If gear, 5R00612 (fig. 4), at front end of bearing section does not revolve when tested, remove bearing section, 5R00624 (fig. 4), and inspect gears for wear, cracks, rust, broken teeth, or breakage of gear rivet. Remove elbow, 5R00626 (fig. 4), and inspect gear, 5R00614 (fig. 4), on shaft of rear section for same deficiencies. Replace gears from spare parts stock as indicated, using tapered gear rivet, 5R00616 (fig. 4), from stock. When gears are replaced, care must be exercised to replace in proper relationship to each other. The two gears, 5R00614 (fig. 4), which mesh at the elbow are identical, but they are not interchangeable with the front gear, 5R00612 (fig. 4), of the bearing section. Doubt as to the identity of

DENTAL HANDPIECES

the gears will be overcome by comparative inspection. The identical gears, 5R00614 (fig. 4), are cut with a flat end blade while the front gear, 5R00612 (fig. 4), has teeth cut with a pitch toward the gear shaft for proper engagement with the burtube gear. When all gears are in proper condition and Engine, Handpiece, Angle, is assembled as in 34d, excluding the head, the test will cause the front gear, 5R00612 (fig. 4), of the bearing section to revolve. Reassemble head as in 34d.

e. When necessary to replace gears as in d, examine defective gear to select small end of tapered gear rivet, 5R00616 (fig. 4). Place gear in a vise, in such a position as to be able to drive out rivet by means of a punch tool for removing rivets or a hammer and a suitable size broken straight bur with tapered shank. Remove gears from gear shaft by pulling on opposite end of shaft with pliers before releasing defective gear from vise. Thoroughly clean gear shaft with fine abrasive cloth. Clean bearing for shaft by soaking in solvent and repeatedly passing shaft through bearing. To replace shaft bearing, insert gear shaft into replacement gear, carefully aligning holes in shaft and gear. Insert small end of new gear rivet into hole and drive firmly in place with hammer. Trim excess of rivet as close as possible with nippers and file any remaining excess to contour of gear with a small flat file until it is flush with the gear surface.

38. Failure of bur to rotate and locking of whole assembly.--This condition will be caused by one of the following:

a. Worn or broken gears which do not mesh properly may jam and prevent bur rotation. Disassemble Engine, Handpiece, Angle, as in 34a. Test as in 37a. Replace defective gears as indicated in 37d and 37e.

b. Rust or accumulation of foreign matter will bind moving parts. Correct by disassembling and cleaning as in 34 and 37e and lubricating as in 35.

c. Binding of burtube, 5R00606 (fig. 4), in head assembly. Remove burtube cap, 5R00608 (fig. 4), and place spacing washer under same.

SECTION 3 - FOURTH AND FIFTH ECHELON MAINTENANCE.

39. Scope.--In addition to the maintenance outlined in section 2 for the first and second echelons, fourth and fifth echelons are authorized to effect the following repairs.

40. Reconditioning head assemblies.--Defective head assemblies returned from first and second echelons will be reconditioned as follows:

a. Disassemble and clean as in 34a.

b. Inspect head housing, 5R00604 (fig. 4), and burtube, 5R00606 (fig. 4), carefully to determine if back bearing, 5R00610 (fig. 4), for burtube is still assembled in head housing. If not, it is necessary to supply new back bearing from stock for soldering into housing. If necessitated by condition of threads or latch slot or general exterior appearance of housing, replace housing.

c. If back bearing, 5R00610 (fig. 4), is assembled in housing, 5R00604 (fig. 4), check its condition by assembling head complete with a bur latch, 5R00618 (fig. 4). Burtube, 5R00606 (fig. 4), should be inspected for wear of gear teeth, rust or separation of ring gear from tube, and replaced if necessary.

d. To check assembled head, insert a bur and manually rotate it. Test for smooth easy turning and also for the amount of motion at right angles to the long

DENTAL HANDPIECES

axis of the bur. Check this motion by holding housing, 5R00604 (fig. 4), in a vise and endeavoring to move bur from side to side along its long axis. Any amount of motion which is visually perceptible, or which can be felt by the fingers is unsatisfactory.

e. To eliminate undue looseness of the bur revealed by this test, it is necessary to replace the burtube back bearing, 5R00610 (fig. 4), and the front bearing which is the cap, 5R00608 (fig. 4). In the event of replacement of the head housing, 5R00604 (fig. 4), at the same time, the back bearing may already be assembled with head housing. If it is not, or if the old housing is to be used, it is necessary to proceed as explained in paragraph 41.

41. Removing the back bearing, 5R00610 (fig. 4), from the head, 5R00604 (fig. 4).--When the old head contains a bearing to be removed, proceed as follows:

a. Insert head holding tool into right hand thread, and hold head in a bunsen flame for about 10 seconds to melt solder. Strike open end of head on work bench to dislodge old bearing. Cool head by immersing in cold water. Insert reaming tool to prepare for new bearing, and turn with even and slight pressure to remove remaining old solder and to clean surface for new bearing.

b. Prepare new bearing, 5R00610 (fig. 4), by dipping into liquid flux and mounting on bearing holding tool. By means of pencil type soldering iron, tin outer flat surface of bearing on side which joins the barrel. Place bearing on inserting tool and, after painting tinned surface with flux, insert tool and bearing as far as possible into left hand thread. By means of both tools now inserted into head, hold in flame for about 10 seconds turning left hand thread tool slightly to seat bearing when solder is soft. Cool in water and remove inserting tool. Insert reaming tool and turn carefully to remove excess solder only.

c. Assemble with new burtube, 5R00606 (fig. 4), and new cap, 5R00608 (fig. 4), and test manually with bur latch, 5R00618 (fig. 4), open for free turning of new bur. If tight, use a very fine abrasive compound between back bearing, 5R00610 (fig. 4), and burtube into which lapping tool is inserted. Rotate lapping tool, by means of a bur chuck on a lathe operated at low speed, until burtube turns freely. Carefully remove abrasive with solvent. Test as before with bur latch closed. If burtube is again tight, it can be assumed that bearing has not been soldered far enough into housing and latch is binding bur at latch slot. Correct by carefully repeating soldering procedure.

d. Assembly by inserting cap, 5R00608 (fig. 4), into left hand thread until shoulder of cap rests on housing, 5R00604 (fig. 4). Burtube, 5R00606 (fig. 4), should rotate freely when manually tested with a bur, and there should be a minimum of end play when latch, 5R00618 (fig. 4), is closed. If burtube is locked or rotates tightly when cap is in place, remove cap and place a .002 or .005 spacing washer, or both, under shoulder of cap, as indicated by trial procedure. This correction will not be necessary if back bearing has been properly installed.

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